ISSN 1713-7845

JOURNAL

of the ENTOMOLOGICAL SOCIETY OF ONTARIO

Volume
One Hundred and Forty Nine
2018

Published 2018

JOURNAL OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO VOLUME 149 2018

ISSN 1713-7845

JOURNAL
of the
ENTOMOLOGICAL SOCIETY
of
ONTARIO
Volume One Hundred and Forty Nine
2018

NEW RECORDS AND RANGE EXTENSIONS OF BUMBLE BEES (*BOMBUS* SPP.) IN A PREVIOUSLY UNDERSAMPLED REGION OF NORTH AMERICA'S BOREAL FOREST

S. D. GIBSON[1,4], K. BENNETT[2], R. W. BROOK[2], S. V. LANGER[3], V. J. MACPHAIL[4], AND D. V. BERESFORD[1*]

[1]School of the Environment and Department of Biology, Trent University, 2140 East Bank Drive, Peterborough, Ontario, Canada K9L 1Z8
email, davidberesford@trentu.ca

Abstract

J. ent. Soc. Ont. 149: 1–14

Northern Ontario, Canada, is one of the few places in North America with little to no data on the local/resident bumble bee fauna. This region is rich in mineral resources and is at risk of being developed for resource extraction before its fauna are catalogued. We report on 220 individuals from 11 species of bumble bees (*Bombus* spp.) collected as part of large scale biodiversity surveys of northern Ontario and Akimiski Island, Nunavut from 2009-2015. Bees were collected using several methods, including Malaise traps, pan traps, pitfalls, Nzi traps, and sweep netting. We report a first record of *B. ternarius* Say from Nunavut, new records for *B. melanopygus* Nylander, and *B. sylvicola* Kirby in Ontario, and new range extensions or gap infills for *B. borealis* Kirby, *B. flavidus* Eversmann, *B. flavifrons* Cresson, *B. frigidus* Smith, *B. terricola* Kirby, *B. vagans* Smith, and confirm the presence of *B. polaris* Curtis and *B. sandersoni* Franklin in this region. We discuss how development and resource extraction may affect *B. terricola* habitat.

Published February 2018

* Author to whom all correspondence should be addressed.
[2] Wildlife Research and Monitoring Section, Ontario Ministry of Natural Resources and Forestry, Trent University, DNA Building, 2140 East Bank Drive, Peterborough, Ontario, Canada K9L 1Z8
[3] Environmental and Life Sciences, Trent University, 2089 East Bank Drive, Peterborough, Ontario, Canada, K9L 1Z8Forestry, Trent University, DNA Building, 2140 East Bank Drive, Peterborough, Ontario, Canada K9L 1Z8
[4] Faculty of Environmental Studies, York University, 4700 Keele Street, North York, Ontario, Canada M3L 1P3

Introduction

A basic unit in biogeography is a species' range. Management decisions regarding conservation and habitat restoration require such range data, especially for groups such as insect pollinators. Bumble bees *(Bombus* Latreille spp.) are important pollinators of both wild plants and agricultural crops in temperate regions (Cameron *et al*. 2010; Williams *et al*. 2014). In some cases, bumble bees are even more efficient at pollinating agricultural crops than managed species such as honey bees (*Apis mellifera* L.), due to their adaptation to a variety of climates and their ability to collect large loads of pollen in their dense hair (Winter *et al.* 2006). In eastern North America, many populations of bumble bee species are declining (Goulson *et al*. 2008; Williams and Osborne 2008; Cameron *et al*. 2010; Colla *et al*. 2012; Kearns and Oliveras 2012; Szabo *et al*. 2012; COSSARO 2014; Jha 2015; COSEWIC 2015; Kerr *et al*. 2015; Crone and Williams 2016). Bumble bees are sensitive to habitat fragmentation due to their limited flight range, long colony cycle, and specific feeding requirements (Grixti *et al*. 2009), making it likely that more populations will be threatened as habitats become more isolated (Williams *et al*. 2014).

In North America, except for the arctic region, northern Ontario, Canada, is one of the few places with little to no data on what bumble bees are present (Laverty and Harder 1988; Williams *et al*. 2014). Records from northern Quebec, Manitoba, and Nunavut suggest that similar bumble bee species assemblages likely occur across northern Ontario. This region, rich in mineral resources, is at risk of being developed for resource extraction before its fauna are even catalogued (FNSAP 2010).

To redress this dearth of species' records, the Ontario Ministry of Natural Resources and Forestry (OMNRF) has been sampling invertebrates across northern Ontario since 2009 (Ontario Biodiversity Council 2015) as part of a larger, multi-taxa survey called the Far North Biodiversity Project (FNBP) (Ringrose *et al*. 2013). Our study reports on the bumble bees collected as part of this project, as well as bumble bees collected from associated studies undertaken near Moosonee, Ontario, and on Akimiski Island, Nunavut.

Using published species distribution maps (Williams *et al*. 2014), we expected to find between five and ten bumble bee species in northern Ontario and Akimiski Island, Nunavut. In this paper we report on our collections of 11 species, three of which confirm a more northern range, three which are range gap infills, two which are species range confirmations, and as far as we are aware based on the literature examined, three first or second provincial/territorial records.

Materials and Methods

Insect Collections

Ontario: Bumble bees were collected in Ontario's Far North (FN) (50° N to Hudson Bay, Ontario Biodiversity Council 2015) from June to August of 2009 to 2014 from 538 sites (534 FN sites, three other Ontario sites, one on Akimiski Island) located in two ecozones: Hudson Plains and Boreal Shield (Ecological Stratification Working Group 1995, Ontario 2016). Bumble bees were collected as part of a general insect survey and access to each site was by helicopter, which limited the material that could be used in this

survey. Sampling was conducted using a variety of methods: pitfall traps; pan traps (yellow, white, and blue plastic bowls); Malaise traps; blue and black cloth Nzi traps (Mihok 2002); and aerial netting, comprised of 5 minutes of sweeping vegetation per day; and incidental catches. Pitfall traps were made from 500 mL plastic cups (beer cups, white inside) containing roughly 100 mL propylene glycol (non-toxic RV antifreeze). These were set so the top rim was level with the soil surface. Pan trapping was conducted using nine plastic coloured bowls with soapy water inside, (three each of white, yellow, and blue) set into the ground and placed with alternating coloured bowls 2.25 m apart. Malaise traps (6 m trap model no. 2877, BioQuip Products 2321 Gladwick Street, Rancho Dominguez, CA 90220, USA) and Nzi traps (blue and black cloth traps designed for biting flies, Mihok 2002) were outfitted with collecting heads containing 70% denatured ethanol and collected each day. Sweep net samples were collected each day (between 8 am and 4 pm) using a meshed sweep net while walking along a path between trapping locations.

Specimens were also collected in Moosonee (2015), Burnt Point (2011) by DB, and Peawanuck (2011) by KB from mid-July to August 1. Bees were sampled by aerial netting and using pan traps (white, pink, yellow, light blue and dark blue) filled with soapy water.

Nunavut: Specimens were collected on Akimiski Island from mid-July to August 1, 2009 to 2015 by aerial netting and with a malaise trap, Nzi trap, and pitfall traps.

Specimen Preparation

Netted specimens were killed in bottles containing ethyl acetate, pinned, labelled, and stored for later identification. All daily trap collections were stored in 250 mL plastic bottles filled with 80% denatured ethanol, for later sorting, preparation, and identification.

Specimens from the trap collections were prepared following the methods outlined by Droege (2009). Essentially each bee was washed in a bath of dish soap and distilled water by gently rocking the container for 1-2 minutes to remove debris, rinsed in water, then rinsed in 100% ethanol, and blotted. Bees were then dried in a jar using a blow dryer for 2 to 5 minutes until dry to reveal characteristics needed for identification (Williams *et al*. 2014), pinned and labeled.

All bumble bees are currently housed at Trent University in the Entomology Lab Insect Collection in Peterborough, Ontario, except for voucher specimens that have been sent to the Canadian National Collection (CNCI), Ottawa, Ontario.

Species identifications were done by the authors (SG, VM, DB) using the keys found in Williams *et al*. (2014). Identifications were confirmed by Sheila Colla (York University), and Paul H. Williams (Natural History Museum, London, UK).

Current known ranges were obtained using published records (Laverty and Harder 1988, Williams *et al*. 2014), the CNCI collection records in Ottawa (http://www.cnc-ottawa.ca/taxonomy [accessed February 2017]), and records from the Kansas University Biodiversity Institute collection (https://Biodiversity.ku.edu/entomology).

Results and Discussion

We caught 220 bumble bee specimens representing 11 species; 163 from northern Ontario (11 species) and 57 from Akimiski Island, Nunavut (5 species) (Table 1). The most abundant species was *Bombus frigidus* Smith, which was 38% of the Ontario catch and 9% of the Akimiski catch. On Akimiski Island, *B. ternarius* Say was the most common, at 36.8% (21/57). The least abundant species was *B. borealis* Kirby, with only one individual caught (Table 1). The locations are mapped in Fig. 1 (see Appendix 1 for geographic coordinates).

New Records

Bombus melanopygus Nylander is a northern species, common in the tundra/taiga region of Alaska, through the northern Great Plains, and occurs in British Columbia, Alberta, Saskatchewan, Manitoba, Quebec, Labrador, Yukon, Northwest Territories, and Nunavut (Laverty and Harder 1988), although Williams *et al*. (2014) state that there are "apparently disjunct populations" in the Arctic and northern Ontario. Provancher (1888) reported this species in Ottawa (see Sheffield and Perron 2014 for details regarding these specimens). We are aware of two other records for this species from Ontario, which we examined (University of Kansas collection, KSEM654572 and KSEM654573), with likely coordinates of 52.11053°N and 94.73477°W, which is about 40 km east of the Manitoba border (Z. Falin pers. comm.). Our study thus confirms the range of *B. melanopygus* in the eastern part of Ontario and provides a southward range extension in Nunavut of the species from near Baffin Island, to Akimiski Island.

TABLE 1: Summary of *Bombus* species caught in northern Ontario and Akimiski Island, Nunavut from 2009-2015, including the numbers of locations where each species was caught.

Species	Akimiski, Nunavut		Northern Ontario		Total	No.
	females	males	females	males	catch	sites
Bombus borealis			1		1	1
Bombus flavidus			1	4	5	4
Bombus flavifrons		1	3		4	3
Bombus frigidus	16	4	56	27	103	53
Bombus melanopygus	3	1	2	1	7	1
Bombus polaris			5		5	1
Bombus sandersoni			25	4	29	22
Bombus sylvicola	9	2	5	1	17	3
Bombus ternarius	21		9		30	8
Bombus terricola			8	1	9	7
Bombus vagans			10		10	4
Total	49	8	125	38	220	

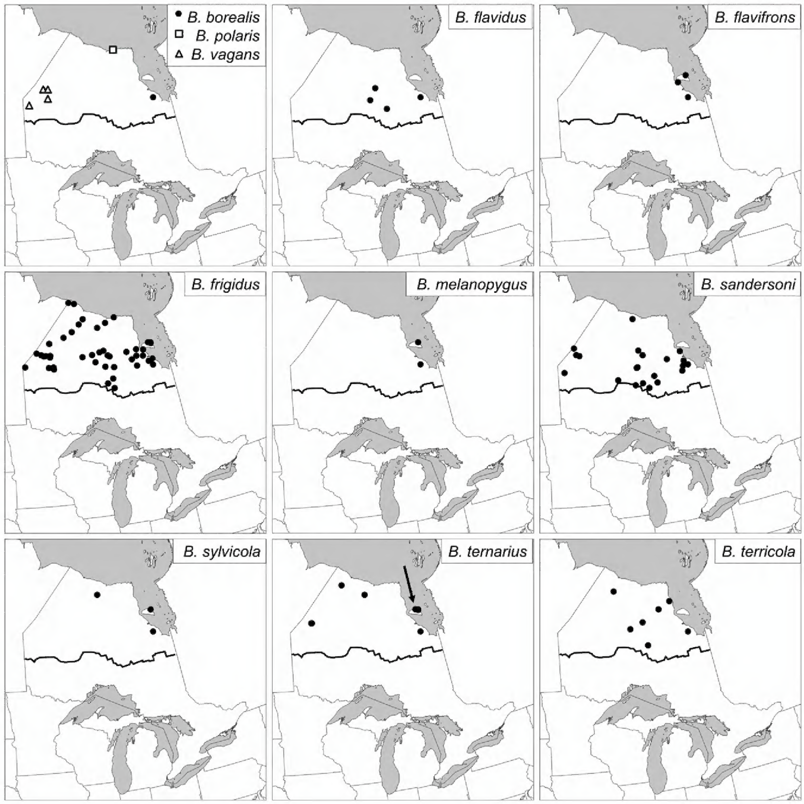


FIGURE 1. Maps showing the province of Ontario, Canada; Akimiski Island, Nunavut, Canada (arrow); and northeastern USA, with the collecting locations for the 11 *Bombus* species caught in northern Ontario and Akimiski Island from 2009-2015. The horizontal line across each map is the boundary of Ontario's Far North. *B. ternarius* is a first record for the territory of Nunavut, from Akimiski Island.

Bombus sylvicola Kirby occurs throughout North America from the Mountain West of Canada and the United States to the tundra/taiga region of Alaska to Newfoundland Island (Williams *et al*. 2014). A single individual (University of Kansas collection, record KSEM652079, seen and verified by the authors) has been recorded from the same site and date as the *B. melanopygus* records (above). Laverty and Harder (1988) report the occurrence of *B. sylvicola* along Hudson's Bay and James Bay, Beresford (2011) found this species in Polar Bear Provincial Park, and there is a single record from near Long Point, Norfolk County Ontario (CNCI). Williams *et al*. (2014) do not report the occurrence of this species in Ontario. *Bombus sylvicola* is a common species found throughout Nunavut (except Akimiski Island) (Williams *et al*. 2014). This study adds a new record from northern Ontario, and also extends the known Nunavut range southward to include Akimiski Island.

Bombus ternarius Say is widespread in Canada and the United States (Williams *et al*. 2014). Laverty and Harder (1988) report the widespread occurrence of *B. ternarius* in southern Ontario. In northern Ontario, this species has been found near Attawapiskat, which is on the mouth of the Attawapiskat river on James Bay, from specimens collected before 1996 (Williams *et al*. 2014). Our study extends that range to include Nunavut through sampling efforts on Akimiski Island, about 80 km from Attawapiskat. In our study, this was one of the least widespread species, with 30 individual caught at only eight sampled sites (Table 2, Fig. 1).

Range Extensions, Infills and Confirmations

Bombus borealis Kirby occurs throughout the eastern half of Canada, with records from central Ontario (Laverty and Harder 1988, Williams *et al*. 2014), Ontario's Hudson Bay coast (Beresford 2011), and from the James Bay area of Quebec (1949) and Moosonee (1952, Canadian National Collection). Our collections extend the species range into northern Ontario where it has not been previously recorded.

Bombus flavidus Eversmann is a cuckoo bumble bee in the subgenus *Psithyrus,* a group which parasitizes social bumble bee species. This species occurs in all provinces and territories of Canada (Williams *et al*. 2014). Williams *et al*. (2014) report scattered records of *B. flavidus* from the tundra/taiga region of Canada, but not in northern Ontario. Our reports infill the known range of *Bombus flavidus* to include northern Ontario.

Bombus flavifrons Cresson is a northern and western species, with Ontario records from Moosonee only (Laverty and Harder, 1988), with Nunavut records from near Kugluktuk (Williams *et al*. 2014). All of these specimens were collected before 1996. Our collections provide support for an eastern infill of the known range within northern Ontario and on Akimiski Island.

Bombus frigidus Smith was the most abundant and widespread species in our study (Table 1, Fig. 1). It occurs in the tundra/taiga and boreal forest region from British Columbia to Manitoba and eastern Ontario to Newfoundland (Williams *et al*. 2014). Laverty and Harder (1988) report one location in the far north of Ontario (near Fort Severn) where a population of *B. frigidus* was discovered, and several locations along James Bay. Our collections provide a range gap infill throughout northern Ontario and on Akimiski Island.

Bombus polaris Curtis is found from Alaska (Williams *et al*. 2014) to northern Quebec and Newfoundland. In Ontario, it is known to occur along the Hudson Bay coast in Polar Bear Provincial Park (Laverty and Harder 1988, Beresford 2011). Our findings confirm the occurrence of *B. polaris* in northern Ontario between 2009 and 2015.

Bombus sandersoni Franklin occurs from the eastern United States and Canada through to the Canadian Great Plains and uncommonly in the tundra/taiga regions of Canada (Williams *et al*. 2014), with a range that includes northern Ontario with records near Moosonee and Attawapiskat (Laverty and Harder, 1988). Our collections provide evidence that this species' range still includes northern Ontario. With 39 specimens spread across 22 sites, this was one of the most widespread species.

Bombus terricola Kirby occurs from Newfoundland through to British Columbia (Williams *et al*. 2014). Our collections expand the known range from a previous northern record from Polar Bear Provincial Park (Beresford 2011). This once common species has declined throughout much of its range (Williams *et al*. 2014) in eastern North America,

reduced to only 19% of its historic abundance (Hatfield *et al*. 2015). Although still geographically widespread, it is now listed as Vulnerable throughout its range by the International Union for Conservation of Nature IUCN (Hatfield *et al*. 2015), and as a species listed as Special Concern in Canada by the Committee On the Status of Endangered Wildlife In Canada (COSEWIC 2015). We caught nine specimens of *B. terricola* at seven sites (Table 2, Fig.1).

Bombus vagans Smith occurs mainly from Newfoundland across southern Ontario and through the United States to the northern Great Plains and westward to the mountains of British Columbia (Williams *et al*. 2014), with some records from northern Alberta and the Hudson Bay coast of Quebec. Both Laverty and Harder (1988) and Williams *et al*. (2014) report the widespread occurrence of *B. vagans* in southern Ontario but no records in northern Ontario, which is probably due to a paucity of samples. Our collection extends the range of *B. vagans* into northern Ontario.

Bumble bees are not an obscure group; they are easily caught, can be identified with the availability of good quality published keys, and generally one of the better-known groups of large insects in any given area, all of which contribute to their presence or absence in a landscape being noticeable. Northern Ontario is an area rich in mineral resources. There has been recent interest shown in developing the large chromite deposits in this region, known as the Ring of Fire deposits (Ontario Ministry of Northern Mines and Development 2017). In our survey, we caught one species of Special Concern in this area, *B. terricola* (COSEWIC 2015), as well as *B. frigidus* and *B. sandersoni*. Reckless resource extraction has historically destroyed habitat across northern Ontario (Hilson 2000), and large scale mineral extraction and the concomitant loss of habitat across this region could reduce this species even further. Because of this, we recommend that protection of habitat for this species be incorporated in any industrial development in this area (Goodland 2012).

Acknowledgements

Financial and logistic support for the Far North Biodiversity Project and other insect collecting was provided by the Ontario Ministry of Natural Resources and Forestry; and the authors thank Ken Abraham, Bill Crins, Dennis Donovan, Dave Etheridge, Dean Phoenix, Paul Sampson, Don Sutherland, Jane Toppozini, and Bob Watt. We also thank the communities of Peawanuck, Marten Falls, Webequie, Nibinamik, Kitchenuhmaykoosib Inninuwug, Keewaywin, Fort Albany, and Fort Severn for their hospitality and access to their traditional lands; the field crews who collected and provided the FNBP and Akimiski samples used in this paper; Julie Belliveau, Kaitlyn Fleming, and Kathryn Veszenyi for access to their samples; Trent Entomology for providing equipment and space for the collections; Dr. Zachary H. Falin (Collections Manager, Division of Entomology, KU Biodiversity Institute in Lawrence Kansas) for providing records. Finally, the authors thank Dr. Sheila R. Colla (Faculty of Environmental Studies at York University, Toronto, Ontario), and Dr. Paul H. Williams (Natural History Museum, London, UK), for their assistance and expertise in confirming the identifications.

References

Beresford, D. 2011. Insect collections from Polar Bear Provincial Park, Ontario, with new records. *Journal of the Entomological Society of Ontario* **142**: 19–27.

Cameron, S.A., Lozier, J.D., Strange, J.P., Kock, J.B., Cordes, N., Solter, F.L. and Griswold, T.L. 2010. Patterns of widespread decline in North American bumble bees. *Proceedings of the National Academy of Science* **108**: 662–667. doi: 10.1073/pnas.1014743108.

Colla, S.R., Gadallah, F., Richardson, L., Wagner, D., and Lawrence, G. 2012. Assessing declines of North American bumble bees (*Bombus* spp.) using museum specimens. *Biodiversity Conservation* **21**: 3585–3539. doi: 10.1007/s10531-012-0383-2.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2015. Assessment and status report on the Yellow-banded Bumble Bee *Bombus terricola* in Canada. Ottawa, Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO). 2014. Ontario species at risk evaluation report for gypsy cuckoo bumble bee (*Bombus bohemicus*). Ontario, Canada.

Crone, E.E. and Williams, N.M. 2016. Bumble bee colony dynamics: quantifying the importance of land use and floral resources for colony growth and queen production. *Ecology letters* **19**: 460–468. doi: 10.1111/ele.12581.

Droege, S. 2009. How to Wash Bees [online]. http://www.slideshare.net/sdroege/how-to-wash-bees [accessed September 2016].

Ecological Stratification Working Group. 1995. A national ecological framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for land and Biological Resources Research and Environment Canada. State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull, Report and national map at 1: 17,500,000 scale.

Far North Science Advisory Panel (FNSAP). 2010. Science for a changing Far North. The Report of the FNSAP. A report submitted to the Ontario Ministry of Natural Resources. Queen's Printer for Ontario, Toronto, Ontario, Canada.

Goodland, R. 2012. Responsible mining: the key to profitable resource development. *Sustainability* **4**: 2099–2126. doi: 10.3390/su4092099.

Goulson, D., Lye, G.C., and Darvill, B. 2008. Decline and conservation of bumble bees. *Annual Review of Entomology* **53**: 191–208. doi: 10.1146/annurev.ento.53.103106.093454.

Grixti, J.C., Wong, L.T., Cameron, S.A., and Favret, C. 2009. Decline of bumble bees (*Bombus*) in the North American Midwest. *Biological Conservation* **142**: 75-84. doi: 10.1016/j.biocon.2008.09.027.

Hatfield, R., Jepsen, S., Thorp, R., Richardson, L., and Colla, S. 2015. *Bombus terricola*. The IUCN Red List of Threatened Species 2015: e.T44937505A46440206 [online]. http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T44937505A46440206.en [accessed February 2017].

Hilson, G., 2000. Sustainable development policies in Canada's mining sector: an overview of government and industry efforts. *Environmental Science and Policy* **3**: 201–211. doi: 10.1016/s1462-9011(00)00086-1.

Jha, S. 2015. Contemporary human-altered landscapes and oceanic barriers reduce bumble

bee gene flow. *Molecular Ecology* **24**: 993–1006. doi: 10.1111/mec.13090.

Kearns, C.A., and Oliveras, D. 2012. Conservation status and population structure of abundant and declining bumblebee species. Annual Report Boulder County Parks and Open Space [online]. https://assets.bouldercounty.org/wp-content/uploads/2017/03/research-report-2012kearns.pdf [accessed March 2016]

Kerr, J.T, Pindar A., Galpern P., Packer L., Roberts S.M., Rasmont P., Schweiger O., Colla S.R., Richardson L.L., Wagner D.L., Gall L.F., Sikes D.S., and Pantoja, A. 2015. Climate change impacts on bumblebees converge across continents. *Science* **349**: 177–180. doi: 10.1126/science.aaa7031.

Laverty, T.M. and Harder, L.D. 1988. The bumble bees of eastern Canada. *Canadian Entomologist* **120**: 965–987. doi: 10.4039/ent120965-11.

Mihok, S. 2002. The development of a multipurpose trap (the Nzi) for tsetse and other biting flies. *Bulletin of Entomological Research* **92**: 385–403. doi: 10.1079/ber2002186.

Ontario Biodiversity Council. 2015. State of Ontario's Biodiversity. Peterborough, Ontario.

Ontario Ministry of Northern Mines and Development 2017. Ring of Fire Secretariat [online]. https://www.mndm.gov.on.ca/en/ring-fire-secretariat. [accessed March 2016]

Provancher, L. 1888. Additions et corrections au Volume II de la Faune Entomologique du Canada. Traitant des Hyménoptères. C. Darveau, Ville de Québec, Canada.

Ringrose, J.L., Abraham, K.F., and Beresford, D.V. 2013. New range records of mosquitoes (Diptera: Culicidae) from northern Ontario. *Journal of the Entomological Society of Ontario* **144**: 3–14.

Sheffield, C.S. and Perron, J.M. 2014. Annotated catalogue of the bees described by Léon Provancher (Hymenoptera: Apoidea). *The Canadian Entomologist* **146**: 117–169. doi: 10.4039/tce.2013.64.

Szabo, N.D., Colla, S.R., Wagner D.L., Gall, L.F. and Kerr, J.T. 2012. Do pathogen spillover, pesticide use, or habitat loss explain recent North American bumblebee declines? *Conservation Letters* **5**: 232–239. doi: 10.1111/j.1755-263x.2012.00234.x.

Williams, P.H. and Osborne, J.L. 2008. Bumblebee vulnerability and conservation world-wide. *Apidologie* **40**: 367–387. doi: 10.1051/apido/2009025.

Williams, P., Thorp, R., Richardson, L., and Colla, S. 2014. *The Bumble Bees of North America: An Identification Guide*. Princeton University Press, Princeton, New Jersey. doi: 10.1515/9781400851188.

Winter, K., Adams, L., Thorp, R., Inouye, D., Day, L., Ascher, J. and Buchman, S. 2006. Importation of non-native bumble bees in to North America: Potential consequences of using *Bombus terrestris* and other non-native bumble bees for greenhouse crop pollination in Canada, Mexico, and the United States. North American Pollinator Protection Campaign (NAPPC). NAPPC Washington, 33 p.

APPENDIX 1. Locations, sex, trap type and dates of *Bombus* spp. caught in northern Ontario and Akimiski Island, Nunavut, listed within each species by date of capture.

Location	Sex	Trap	Date	Latitude	Longitude
			Bombus borealis		
Ontario	F	Pan Trap	25-Jul-15	51°39'60"N	81°17'60"W
			Bombus flavidus		
Ontario	M	Netted	18-Jul-13	52°8'50"N	86°37'16"W
Ontario	M	Netted	18-Jul-13	52°8'50"N	86°37'16"W
Ontario	M	Netted	22-Jul-13	51°23'48"N	85°2'58"W
Ontario	M	Netted	23-Jul-13	52°51'57"N	85°51'3"W
Ontario	F	Pan Trap	25-Jul-15	51°39'60"N	81°17'60"W
			Bombus flavifrons		
Nunavut	M	NZI	21-Jul-10	53°6'18"N	80°57'25"W
Ontario	F	Netted	7-Jun-12	52°46'27"N	81°57'29"W
Ontario	F	Netted	10-Jun-12	52°46'27"N	81°57'29"W
Ontario	F	Pan Trap	21-Jul-15	51°39'60"N	81°17'60"W
			Bombus frigidus		
Nunavut	F	Netted	20-Jul-09	53°6'18"N	80°57'25"W
Nunavut	F	Netted	18-Jul-10	53°6'18"N	80°57'25"W
Nunavut	F	NZI	18-Jul-10	53°6'18"N	80°57'25"W
Nunavut	F	NZI	19-Jul-10	53°6'18"N	80°57'25"W
Nunavut	F	NZI	20-Jul-10	53°6'18"N	80°57'25"W
Nunavut	M	Netted	22-Jul-10	53°6'18"N	80°57'25"W
Nunavut	F	NZI	17-Jul-11	53°6'18"N	80°57'25"W
Nunavut	F	Pitfall	19-Jul-11	53°4'2"N	80°58'14"W
Nunavut	F	NZI	26-Jul-11	53°6'18"N	80°57'25"W
Nunavut	M	NZI	26-Jul-11	53°6'18"N	80°57'25"W
Nunavut	F	NZI	20-Jul-12	53°6'18"N	80°57'25"W
Nunavut	F	Malaise	22-Jul-12	53°6'18"N	80°57'25"W
Nunavut	F	Netted	25-Jul-12	53°9'41"N	81°15'24"W
Nunavut	M	Netted	29-Jul-13	53°6'18"N	80°57'25"W
Nunavut	F	Pitfall	29-Jul-13	53°4'2"N	80°58'14"W
Nunavut	F	Pitfall	29-Jul-13	53°4'2"N	80°58'14"W
Nunavut	F	Netted	30-Jul-13	53°6'18"N	80°57'25"W
Nunavut	F	Malaise	31-Jul-14	53°6'18"N	80°57'25"W
Nunavut	M	Malaise	19-Jul-15	53°6'18"N	80°57'25"W
Nunavut	F	NZI	19-Jul-15	53°6'18"N	80°57'25"W
Ontario	F	Netted	4-Jun-10	52°46'51"N	85°40'26"W
Ontario	F	Netted	13-Jun-10	52°33'36"N	87°17'54"W
Ontario	F	Malaise	15-Jun-10	52°33'36"N	87°17'54"W
Ontario	M	Netted	30-Jun-10	52°10'9"N	86°19'30"W
Ontario	F	Netted	July 2010	53°13'8"N	86°13'31"W
Ontario	F	Netted	5-Jul-10	53°3'52"N	87°30'55"W
Ontario	F	Netted	5-Jul-10	53°3'52"N	87°30'55"W
Ontario	F	Pitfall	11-Jun-11	54°9'23"N	92°1'44"W
Ontario	F	Netted	12-Jun-11	54°9'45"N	92°2'37"W
Ontario	F	Netted	19-Jun-11	54°27'19"N	90°21'59"W
Ontario	F	Netted	23-Jun-11	55°14'29"N	84°19'4"W
Ontario	F	Netted	29-Jun-11	52°44'48"N	94°54'29"W
Ontario	M	Pitfall	2-Jul-11	53°27'46"N	93°2'33"W

APPENDIX 1 continued…

Location	Sex	Trap	Date	Latitude	Longitude
Ontario	M	Netted	2-Jul-11	53°22’1”N	92°3’59”W
Ontario	F	Netted	3-Jul-11	52°35’5”N	91°50’30”W
Ontario	M	Netted	3-Jul-11	52°35’3”N	91°50’40”W
Ontario	M	Netted	3-Jul-11	52°35’5”N	91°50’30”W
Ontario	F	Netted	4-Jul-11	53°22’38”N	92°46’31”W
Ontario	F	Netted	4-Jul-11	53°22’41”N	92°42’31”W
Ontario	M	Pitfall	4-Jul-11	53°22’38”N	92°46’31”W
Ontario	M	Netted	4-Jul-11	53°22’36”N	92°32’25”W
Ontario	M	Netted	4-Jul-11	53°22’41”N	92°42’31”W
Ontario	M	Netted	4-Jul-11	53°22’41”N	92°42’31”W
Ontario	M	Netted	4-Jul-11	53°22’41”N	92°42’31”W
Ontario	M	Netted	4-Jul-11	53°22’51”N	92°46’29”W
Ontario	M	Netted	4-Jul-11	53°22’38”N	92°46’31”W
Ontario	M	Netted	4-Jul-11	53°22’38”N	92°46’31”W
Ontario	M	Netted	4-Jul-11	53°22’38”N	92°46’31”W
Ontario	F	Netted	5-Jul-11	53°15’41”N	92°6’27”W
Ontario	M	Netted	7-Jul-11	52°27’19”N	91°49’3”W
Ontario	M	Malaise	8-Jul-11	53°36’8”N	93°32’13”W
Ontario	M	Netted	8-Jul-11	52°35’12”N	92°21’0”W
Ontario	M	Netted	9-Jul-11	53°36’6”N	93°32’17”W
Ontario	M	Pitfall	9-Jul-11	53°36’15”N	93°32’9”W
Ontario	F	Netted	20-Jul-11	54°59’43”N	85°26’2”W
Ontario	F	Pitfall	21-Jul-11	54°59’43”N	85°26’2”W
Ontario	F	Netted	10-Jun-12	52°46’27”N	81°57’29”W
Ontario	F	NZI	21-Jun-12	51°58’7”N	81°39’37”W
Ontario	F	Netted	22-Jun-12	51°58’7”N	81°39’37”W
Ontario	F	Netted	23-Jun-12	52°53’33”N	82°41’3”W
Ontario	F	Netted	28-Jun-12	52°28’24”N	82°48’53”W
Ontario	F	Netted	4-Jul-12	52°3’42”N	81°12’27”W
Ontario	F	Netted	4-Jul-12	51°50’25”N	82°59’29”W
Ontario	F	Netted	6-Jul-12	52°23’3”N	82°7’57”W
Ontario	F	Netted	13-Jul-12	52°51’27”N	83°46’58”W
Ontario	F	NZI	15-Jul-12	52°18’23”N	83°23’3”W
Ontario	F	Netted	17-Jun-13	53°1’27”N	88°35’41”W
Ontario	F	Netted	3-Jul-13	50°41’17”N	85°47’7”W
Ontario	F	Netted	4-Jul-13	50°41’7”N	85°46’56”W
Ontario	F	Netted	5-Jul-13	50°41’17”N	85°47’7”W
Ontario	M	Netted	6-Jul-13	50°41’17”N	85°47’7”W
Ontario	M	Pitfall	12-Jul-13	51°3’33”N	86°22’3”W
Ontario	F	Pitfall	14-Jul-13	51°3’33”N	86°22’3”W
Ontario	F	NZI	19-Jul-13	52°2’29”N	85°25’6”W
Ontario	F	Netted	21-Jul-13	52°2’29”N	85°25’6”W
Ontario	M	Netted	21-Jul-13	52°2’17”N	85°25’35”W
Ontario	F	Pan Trap	21-Jul-13	51°19’0”N	85°44’54”W
Ontario	F	NZI	22-Jul-13	51°19’0”N	85°44’54”W
Ontario	F	Netted	23-Jul-13	52°51’57”N	85°51’3”W
Ontario	M	Netted	23-Jul-13	52°51’57”N	85°51’3”W
Ontario	F	Netted	20-Jun-14	54°45’4”N	89°21’43”W
Ontario	F	Netted	25-Jun-14	55°28’55”N	87°52’47”W
Ontario	F	Pitfall	26-Jun-14	55°28’57”N	87°52’50”W

APPENDIX 1 continued…

Location	Sex	Trap	Date	Latitude	Longitude
Ontario	F	Netted	4-Jul-14	56°34’4”N	88°35’35”W
Ontario	F	Netted	5-Jul-14	56°41’9”N	89°14’3”W
Ontario	F	Netted	7-Jul-14	55°10’52”N	88°26’7”W
Ontario	F	Pan Trap	9-Jul-14	54°46’17”N	86°25’34”W
Ontario	F	Pan Trap	21-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	21-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	21-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	21-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	21-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
Ontario	M	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
Ontario	M	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
Ontario	M	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	27-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	27-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Netted	21-27 July 2010	53°9’59”N	86°40’14”W
Ontario	M	Netted	21-27 July 2010	53°9’59”N	86°40’14”W
		Bombus melanopygus			
Nunavut	M	NZI	28-Jul-09	53°6’18”N	80°57’25”W
Nunavut	F	Netted	20-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	NZI	23-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	NZI	19-Jul-15	53°6’18”N	80°57’25”W
Ontario	F	Pan Trap	2-Jul-15	51°39’60”N	81°17’60”W
Ontario	M	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	27-Jul-15	51°39’60”N	81°17’60”W
		Bombus polaris			
Ontario	F	Pitfall	9-Jun-11	55°14’29”N	84°19’4”W
Ontario	F	Pitfall	10-Jun-11	55°14’29”N	84°19’4”W
Ontario	F	Pitfall	12-Jun-11	55°14’29”N	84°19’4”W
Ontario	F	Pitfall	13-Jun-11	55°14’29”N	84°19’4”W
Ontario	F	Pitfall	13-Jul-11	55°14’29”N	84°19’4”W
		Bombus sandersoni			
Ontario	F	Netted	28-Jun-10	52°7’18”N	86°43’47”W
Ontario	F	Netted	July 2010	53°13’8”N	86°13’31”W
Ontario	F	Netted	29-Jun-11	53°28’6”N	93°2’6”W
Ontario	F	Netted	1-Jul-11	52°21’16”N	94°27’56”W
Ontario	F	Netted	1-Jul-11	52°21’18”N	94°27’56”W
Ontario	F	Netted	4-Jul-11	53°22’41”N	92°42’31”W
Ontario	M	Netted	4-Jul-11	53°22’41”N	92°42’31”W
Ontario	F	Netted	15-Jul-11	53°54’15”N	93°13’3”W
Ontario	F	Netted	14-Jun-12	51°39’15”N	81°50’58”W
Ontario	F	NZI	20-Jun-12	51°58’7”N	81°39’37”W
Ontario	F	Pan Trap	7-Jul-12	52°38’5”N	81°48’50”W
Ontario	F	Netted	9-Jul-12	51°21’27”N	82°3’20”W
Ontario	F	Netted	11-Jul-12	51°21’27”N	82°3’20”W
Ontario	F	Netted	12-Jul-12	52°18’17”N	83°22’43”W

APPENDIX 1 continued…

Location	Sex	Trap	Date	Latitude	Longitude
Ontario	F	Pitfall	5-Jul-13	51°0’43”N	87°8’46”W
Ontario	F	Netted	6-Jul-13	50°41’17”N	85°47’7”W
Ontario	F	Pitfall	12-Jul-13	50°56’24”N	84°51’11”W
Ontario	M	Pitfall	14-Jul-13	51°3’33”N	86°22’3”W
Ontario	M	Netted	18-Jul-13	52°8’50”N	86°37’16”W
Ontario	F	Netted	21-Jul-13	51°30’19”N	88°52’57”W
Ontario	M	Netted	21-Jul-13	51°30’19”N	88°52’57”W
Ontario	F	Netted	22-Jul-13	51°23’48”N	85°2’58”W
Ontario	F	Netted	23-Jul-13	52°51’57”N	85°51’3”W
Ontario	F	Pan Trap	4-Jul-14	55°19’23”N	86°11’8”W
Ontario	F	Pan Trap	121 July 2015	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	21-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	21-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
Ontario	F	Pan Trap	25-Jul-15	51°39’60”N	81°17’60”W
			Bombus sylvicola		
Nunavut	M	Netted	18-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	NZI	81 July 2010	53°6’18”N	80°57’25”W
Nunavut	F	NZI	18-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	Netted	20-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	Netted	20-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	NZI	19-Jul-11	53°6’18”N	80°57’25”W
Nunavut	F	Netted	24-Jul-11	53°6’18”N	80°57’25”W
Nunavut	F	Netted	24-Jul-11	53°6’18”N	80°57’25”W
Nunavut	M	Netted	24-Jul-11	53°6’18”N	80°57’25”W
Nunavut	F	Malaise	21-Jul-12	53°6’18”N	80°57’25”W
Nunavut	F	Malaise	18-Jul-15	53°6’18”N	80°57’25”W
Ontario	F	Pan Trap	7-Jul-14	54°46’17”N	86°25’34”W
Ontario	F	Netted	9-Jul-14	54°46’17”N	86°25’34”W
Ontario	F	Netted	9-Jul-14	54°46’17”N	86°25’34”W
Ontario	F	Netted	9-Jul-14	54°46’17”N	86°25’34”W
Ontario	M	Netted	9-Jul-14	54°46’17”N	86°25’34”W
Ontario	F	Pan Trap	23-Jul-15	51°39’60”N	81°17’60”W
			Bombus ternarius		
Nunavut	F	Netted	21-Jul-09	53°6’18”N	80°57’25”W
Nunavut	F	Netted	25-Jul-09	53°9’41”N	81°15’24”W
Nunavut	F	NZI	17-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	NZI	17-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	NZI	17-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	Netted	18-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	NZI	19-Jul-10	53°6’18”N	80°57’25”W
Nunavut	F	NZI	17-Jul-11	53°6’18”N	80°57’25”W
Nunavut	F	NZI	19-Jul-11	53°6’18”N	80°57’25”W
Nunavut	F	NZI	19-Jul-11	53°6’18”N	80°57’25”W
Nunavut	F	NZI	24-Jul-11	53°6’18”N	80°57’25”W
Nunavut	F	NZI	25-Jul-11	53°6’18”N	80°57’25”W
Nunavut	F	NZI	17-Jul-12	53°6’18”N	80°57’25”W
Nunavut	F	Malaise	29-Jul-13	53°6’18”N	80°57’25”W
Nunavut	F	Pitfall	29-Jul-13	53°4’2”N	80°58’14”W

APPENDIX 1 continued…

Location	Sex	Trap	Date	Latitude	Longitude
Nunavut	F	Pitfall	29-Jul-13	53°4'2"N	80°58'14"W
Nunavut	F	Pitfall	29-Jul-13	53°4'2"N	80°58'14"W
Nunavut	F	NZI	19-Jul-15	53°6'18"N	80°57'25"W
Nunavut	F	NZI	19-Jul-15	53°6'18"N	80°57'25"W
Nunavut	F	NZI	24-Jul-15	53°6'18"N	80°57'25"W
Nunavut	F	NZI	27-Jul-15	53°6'18"N	80°57'25"W
Ontario	F	Netted	4-Jul-11	53°22'51"N	92°46'29"W
Ontario	F	Netted	4-Jul-11	53°22'41"N	92°42'31"W
Ontario	F	Pitfall	12-Jul-12	51°39'60"N	81°17'60"W
Ontario	F	Netted	25-Jun-14	55°37'18"N	88°50'30"W
Ontario	F	Pan Trap	7-Jul-14	54°46'17"N	86°25'34"W
Ontario	F	Netted	9-Jul-14	54°46'17"N	86°25'34"W
Ontario	F	Pan Trap	25-Jul-15	51°39'60"N	81°17'60"W
Ontario	F	Pan Trap	25-Jul-15	51°39'60"N	81°17'60"W
Ontario	F	Pan Trap	25-Jul-15	51°39'60"N	81°17'60"W
			Bombus terricola		
Ontario	F	Netted	14-Jun-10	52°33'36"N	87°17'54"W
Ontario	F	Netted	13-Aug-11	53°30'31"N	83°50'53"W
Ontario	F	Netted	13-Aug-11	53°52'42"N	82°29'16"W
Ontario	F	Netted	13-Aug-11	53°52'42"N	82°29'16"W
Ontario	F	Pitfall	22-Jul-13	51°19'8"N	85°44'46"W
Ontario	F	Netted	23-Jul-13	52°51'57"N	85°51'3"W
Ontario	F	Netted	7-Jul-14	55°10'52"N	88°26'7"W
Ontario	F	Pan Trap	19-Jul-15	51°39'60"N	81°17'60"W
Ontario	M	Pan Trap	25-Jul-15	51°39'60"N	81°17'60"W
			Bombus vagans		
Ontario	F	Netted	1-Jul-11	52°21'16"N	94°27'56"W
Ontario	F	Netted	4-Jul-11	53°22'51"N	92°46'29"W
Ontario	F	Netted	4-Jul-11	53°22'41"N	92°42'31"W
Ontario	F	Netted	4-Jul-11	53°22'41"N	92°42'31"W
Ontario	F	Netted	9-Jul-11	52°41'9"N	92°27'12"W
Ontario	F	Netted	9-Jul-11	52°41'9"N	92°27'12"W
Ontario	F	Netted	9-Jul-11	52°41'9"N	92°27'12"W
Ontario	F	Netted	9-Jul-11	52°41'9"N	92°27'12"W
Ontario	F	Netted	9-Jul-11	52°41'9"N	92°27'12"W
Ontario	F	Netted	9-Jul-11	52°41'9"N	92°27'12"W

FIRST REPORT OF THE PALEARCTIC SAWFLY *PRISTIPHORA SUBBIFIDA* (THOMSON 1871) (HYMENOPTERA: TENTHREDINIDAE) IN CANADA

M. A. SMITH[1*], D. R. SMITH[2], AND J. R. DEWAARD[3]

Department of Integrative Biology, University of Guelph,
Guelph, Ontario, Canada N1G 2W1
email, salex@uoguelph.ca

Scientific Note *J. ent. Soc. Ont.* 149: 15–19

Species are moved by human activity. The frequency of such movement is increasing in the Anthropocene (Steffen *et al.* 2011). Identifying such translocations is a challenge, especially within the largest and most diverse taxon – the insects. One method to facilitate the identification of these adventives is via DNA associated with publicly accessible DNA barcodes in the Barcode of Life Data System (BOLD) (Ratnasingham and Hebert 2007).

We report here the discovery of a Palearctic sawfly (*Pristiphora subbifida* (Thomson 1871) (Hymenoptera: Tenthredinidae)) in Canada via Malaise trapping paired with DNA barcoding. The detection was contextualised to a species level via inclusion in the DNA barcode library where it was directly comparable to large-scale barcoding initiatives in Europe and Canada.

During the flight season (April – November) in 2009-2011, a Townes-style Malaise trap (Malaise 1937; Townes 1962) was erected in a downtown backyard in Guelph, Ontario, Canada (43.554, -80.264; Fig. 1). The trees in the yard and surrounding area include several maple species (Norway, Manitoba and Sugar - *Acer platanoides* L., *A. negundo* L. and *A. saccharum* Marshall), spruce (*Picea glauca* (Moench) Voss), black walnut (*Juglans nigra* L.), and dogwood (*Cornus* L. spp.). In 16 May 2010, a Malaise trap sample spanning the previous fortnight was collected from the location above. Trap contents were moved to the Biodiversity Institute of Ontario (BIO) where they were sorted, photographed and tissue-sampled for DNA barcoding (Fig. 2) by the collections staff. The DNA barcode produced from the DNA extract of this single sawfly specimen was added immediately to the public library of DNA barcode sequences on the Barcode of Life Data System. There, it received

Published March 2018

* Author to whom all correspondence should be addressed.

[2] Systematic Entomology Laboratory, Agricultural Research Service, c/o National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, MRC 168, Washington, DC 20013-7012, USA

[3] Centre for Biodiversity Genomics, Biodiversity Institute of Ontario, University of Guelph, Guelph, Ontario, Canada N1G 2W1

FIGURE 1. The appearance in 2009 of the location in Guelph, Ontario where the sawfly *Pristiphora subbifida* was captured in 2010. The 2010 location of the Malaise trap is noted with a red box. http://www.gigapan.com/gigapans/26024/

FIGURE 2. Lateral image of the *Pristiphora subbifida* sample, ASGLE397-10, MAS603-10, collected in Guelph, Ontario in May 2010.

a persistent identifier – a Barcode Index Number (BIN) (Ratnasingham and Hebert 2013) (BOLD:AAU8503) indicating that it was genetically unlike any other named or unnamed specimen in the database to that point. This specimen represents the first Canadian record for the Palearctic sawfly *Pristiphora subbifida*. A BOLD dataset with all public records of barcoded individuals of this species are accessible via dx.doi.org/10.5883/DS-ASPRIS.

It is not uncommon for a DNA sequence from hyperdiverse groups (such as the Hymenoptera) to appear first on the Barcode of Life Data System as a BIN lacking a species name. Indeed, national initiatives to barcode a nation's fauna have reported that 35% of the samples processed could not be identified to species by their DNA (Geiger *et al.* 2016). However, the samples in the BOLD database are frequently accessed and regularly curated by taxonomic experts, leading to the regular addition of species epithets to "nameless" BINs. In one recent example, a European species of gall wasp was discovered as an adventive in Canada via a comparison of sequenced and named European samples with BOLD records of Malaise-trapped samples from Canada (Moffat and Smith 2014).

The BIN BOLD:AAU8503 received a name via sequences submitted to BOLD associated with a large initiative in 2010 to sequence and release DNA barcode data for the fauna of Germany, "the Fauna Bavarica" project (Hendrich *et al.* 2010). Several taxonomic groups have recently seen publications emerge from this initiative, including the Symphyta (Schmidt *et al.* 2017). Associated with the Hendrich *et al.* (2010) publication, there were barcode records included for *Pristiphora subbifida*. These records associated the name *Pristiphora subbifida* with the BIN "BOLD:AAU8503" that was created based on the Guelph record. The recognition that this BIN was, in fact, a named Palearctic species and an unexpected adventive to Canada was possible since all sequences were in BOLD.

The record reported here is the first known Canadian occurrence of this Palearctic sawfly. A new national record documented via the public release of *de novo* specimen data in a database that includes accessioned and named museum collections illustrates the value of publicly releasing DNA barcodes towards tracking the movement and arrival of species in the Anthropocene. Intensive surveying by the Biodiversity Institute of Ontario (BIO) across Canada over the last decade (1.6 M DNA barcoded occurrence records), mostly derived from Malaise traps (e.g., Steinke *et al.* 2017), has resulted in no additional records for this species. Such rarity, despite multiple years of continuous trapping, corresponds with infrequent Malaise trap captures reported earlier in the United States (Smith 2016). This might due to such as strong association with the trees, that these (apparently) *Acer* feeding *Pristiphora* do not easily fly into Malaise traps even close by to their associated trees.

Smith (2016) reported the first North American records for *Pristiphora subbifida* based on five individual Malaise trap collections in suburban Virginia and Maryland between 2000 and 2002 and a further two single individuals appeared in each of 2015 and 2016 (Fig. 3). All individuals except one were trapped in April. The recorded host in Europe are *Acer* spp., and thus far only *Acer campestre* L. has been identified unequivocally as a host (Prous *et al.* 2017). The host(s) in North America remains unknown due to their collection via Malaise traps; however, maples were present at all trap sites in the U.S. and Canada. The individual we report here allows us to add more data to our understanding of this adventive. The Guelph sample was also collected later in the year (May) as one would expect for a site farther north in Canada. In addition, the Guelph sample was also intriguingly isolated in an area that is covered in space and time by multiple Malaise traps. Thus, while our

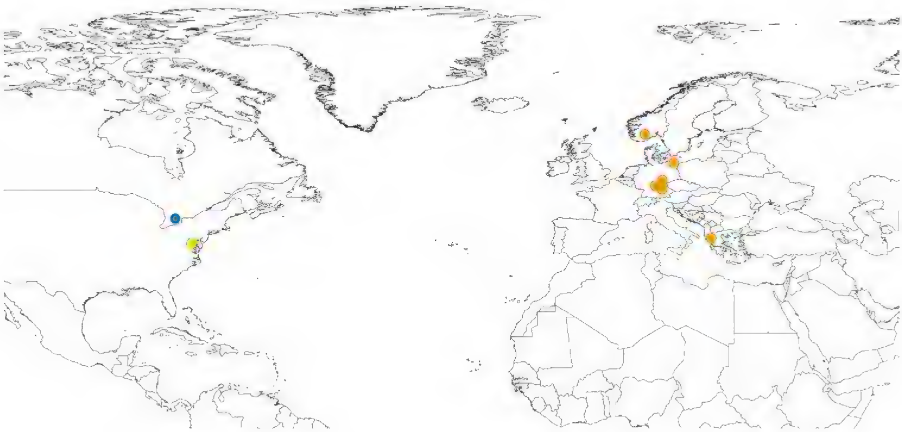


FIGURE 3. Map of the localities of *Pristiphora subbifida* in BOLD (blue and orange) and from Smith (2016) (yellow). Map made with Simplmappr.net (Shorthouse 2010).

collection adds to what we know about the extent of this adventive species in Canada and North America, most elements of the biology of this adventive sawfly in North America remain unknown.

Acknowledgements

We would like to thank two anonymous reviewers whose comments improved an earlier version of this manuscript. This study was supported by the Government of Canada through its ongoing support of Genome Canada, the Biodiversity Institute of Ontario, and the Ontario Genomics Institute (2008–0GI–ICI–03), and by Discovery Grants from the Natural Sciences and Engineering Research Council of Canada to MAS.

References

Geiger, M.F., Moriniere, J., Hausmann, A., Haszprunar, G., Wägele, W., Hebert, P.D.N., and Rulik, B. 2016. Testing the Global Malaise Trap Program – How well does the current barcode reference library identify flying insects in Germany? *Biodiversity Data Journal* **4**: e10671. doi: 10.3897/BDJ.4.e10671.

Hendrich, L., Balke, M., Haszprunar, G., Hausmann, A., Hebert, P., and Schimdt, S. 2010. Barcoding Fauna Bavarica--Capturing central European animal diversity. P 347 In Nimis, P. Nimis P. L. and Vignes Lebbe, R. (eds) Proceedings of the International Congress Tools for Identifying Biodiversity: Progress and Problems. EUT Edizioni

Universit{à} di Trieste.

Malaise, R. 1937. A new insect trap. *Entomologisk Tidskrift* **58**: 148–160.

Moffat, C.E. and Smith, M.A. 2014. Pre-release detection of a biocontrol agent: combining independent and public DNA sequences to identify the first North American record of *Aulacidea pilosellae* (Hymenoptera: Cynipidae). *The Canadian Entomologist* **147**: 390–395. doi: 10.4039/tce.2014.48.

Prous, M., Kramp, K., Vikberg, V., and Liston, A.D. 2017. North-Western Palaearctic species of Pristiphora (Hymenoptera, Tenthredinidae). *Journal of Hymenoptera Research* **59**: 1–190. doi: 10.3897/jhr.29.12656.

Ratnasingham, S. and Hebert, P.D.N. 2007. BOLD: The Barcode of Life Data System. *Molecular Ecology Notes* 7: 355–364. doi: 10.1111/j.1471-8286.2007.01678.x.

Ratnasingham, S. and Hebert, P.D.N. 2013. A DNA-based registry for all animal species: the barcode index number (BIN) system. *PloS ONE* **8**: e66213. doi: 10.1371/journal.pone.0066213.

Schmidt, S., Taeger, A., Morinière, J., Liston, A., Blank, S. M., Kramp, K., Kraus, M., Schmidt, O., Heibo, E., Prous, M., Nyman, T., Malm, T. and Stahlhut, J. 2017. Identification of sawflies and horntails (Hymenoptera, 'Symphyta') through DNA barcodes: successes and caveats. *Molecular Ecology Resources* **17**: 670–685. doi: 10.1111/1755-0998.12614.

Shorthouse, D.P. 2010. SimpleMappr, an online tool to produce publication-quality point maps [online]. http://www.simplemappr.net [accessed 21 July, 2017].

Smith, D.R. 2016. *Pristiphora subbifida* (Thomson) (Hymenoptera: Tenthredinidae), a Palearctic Sawfly New to North America. *Proceedings of the Entomological Society of Washington* **118**: 297–299. doi: 10.4289/0013-8797.118.2.297.

Steffen, W., Grinevald, J., Crutzen, P., and McNeill, J. 2011. The Anthropocene: conceptual and historical perspectives. *Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences* **369**: 842–867. doi: 10.1098/rsta.2010.0327.

Steinke, D., Breton, V., Berzitis, E., and Hebert, P.D.N. 2017. The School Malaise Trap Program: Coupling educational outreach with scientific discovery. *PloS Biology* **15**(4): e2001829. doi: 10.1371/journal.pbio.2001829.

Townes, H. 1962. Design for a Malaise trap. *Proceeding of the Entomological Society Washington* **64**: 253–262.

OBSERVATIONS ON BLACK-HORNED TREE CRICKET, *OECANTHUS NIGRICORNIS* WALKER, FLORAL TISSUE HERBIVORY AND POLLEN TRANSFER OF NEW ENGLAND ASTER, *SYMPHYOTRICHUM NOVAE-ANGLIAE* (L.) G.L.NESOM

H. A. CRAY

School of Environment, Resources and Sustainability, University of Waterloo,
200 University Avenue West, Waterloo, ON, Canada, N2L 3G1
email, heatheracray@gmail.com

Scientific Note *J. ent. Soc. Ont.* 149: 21–26

Despite being a relatively common species in northeastern North America and the object of interest for over a century (Fulton 1915; Coome 2016), surprisingly little is known about the natural feeding habits of the black-horned tree cricket, *Oecanthus nigricornis* Walker (Orthoptera: Gryllidae). This note adds to the natural history knowledge of *O. nigricornis* by presenting evidence of observed feeding behaviour and pollen transfer by a wild individual in southern Ontario, Canada.

Species of *Oecanthus* Serville as a group are described in field guides as feeding on plant parts, some insects, and other materials such as fungi and pollen (Swan and Papp 1972), but very limited species-level information is available about the feeding habits of *Oecanthus* in the wild. Captive *O. nigricornis* have been fed on young potted wheat shoots, raspberry foliage, commercial Tetra Growth Food®TM (Bell 1979), apple slices and 'cricket chow' (Brown and Kuns 2000; Bussière *et al.* 2005; Brown 2008). Experiments with feeding cages containing Gryllidae (including but not limited to *O. nigricornis*) demonstrated a varied diet: plant lice (Sternorrhyncha, Hemiptera); exposed apple branch cambium; the pulp of peaches and plums; scale insects (Hemiptera: Coccoidea); and anthers, outer stalk tissue, and other floral parts of *Daucus carota* Linnaeus (Apiaceae) (Fulton 1915).

There are only two entries in the primary literature reporting the diet of *O. nigricornis* outside of captivity. In the first, it is unclear whether the *O. nigricornis* specimens examined were wild-collected or partially or wholly raised in feeding cages. In this New York-based, USA, study, the crops of an unknown number of *O. nigricornis* specimens were dissected, and in most specimens a large part of the diet was found to consist of plant tissue (leaf hairs and vascular tissue) as well as mycelia and spores of various fungi, although the crops of some specimens contained a few insect remains (Fulton 1915). An observation from Illinois, USA, reports *O. nigricornis* feeding on the floral tissue of *Agalinis auriculata* (Michaux) S.F. Blake (Orobanchaceae), including the petals, ovaries, pistils, and stamens (Mulvaney *et al.* 2006). There are apparently no published Canadian natural history observations dealing with the diet or feeding behaviour of *O. nigricornis*.

Published September 2018

During the course of vegetation fieldwork on 14 September 2017 at 1:14 pm, a female of *O. nigricornis* was observed feeding on the floral tissue of New England aster, *Symphyotrichum novae-angliae* Linnaeus (Asteraceae) in a recently-restored tallgrass prairie at the Glenorchy Conservation Area, Oakville, Ontario. Although there is an established history of tallgrass prairie in the area, the site was in agriculture for the decades prior to 2010 when restoration activities were initiated. The vegetation surrounding the observed behaviour is characterized by early-restoration tallgrass prairie forbs and graminoids (*Symphyotrichum* spp. Ness [Asteraceae], *Solidago* spp. Linnaeus [Asteraceae], *Rudbeckia* sp. Linnaeus [Asteraceae], *Monarda* sp. Linnaeus [Lamiaceae], *Elymus* spp. Linnaeus [Poaceae], *Andropogon* sp. Linnaeus [Poaceae], *Sorghastrum* sp. Nash [Poaceae]) and ruderal weeds (e.g. *Cirsium* spp. Miller [Asteraceae], *Trifolium* spp. Linnaeus [Fabaceae], *Dipsacus* sp. Linnaeus [Caprifoliaceae], *Daucus* sp. Linnaeus [Apiaceae], *Taraxacum* sp. F.H. Wigg [Asteraceae], *Panicum* sp. Linnaeus [Poaceae]).

The individual was observed and photographed engaging in feeding behaviour for ten minutes, during which time it travelled between two different flowers heads. The open (tall), perfect disc florets were targeted on both flower heads, with the individual of *O. nigricornis* moving from one open disc floret to the next within a flower head and concentrating feeding on these structures (Fig. 1). This preference for the open, perfect florets is particularly obvious when looking at the flower head before, during, and after herbivory (Fig. 2). Once the individual of *O. nigricornis* had fed on the desired floral tissue, the rest was discarded (Fig. 3). Pollen transfer to the head, antennae, palps, and legs occurred during feeding, remained after grooming (Fig. 4), and persisted during and after the move to another flower head.

Symphyotrichum novae-angliae (Asteraceae) is an obligate outbreeder, being largely incapable of self-pollination (Chmielewski and Semple 2003) and thus unlikely to benefit from pollen transfer by *O. nigricornis* unless an individual moves between non-clonal plants. Although not impossible, the large number of flowers available simultaneously on *Symphyotrichum novae-angliae* (Asteraceae) means that a single plant will have numerous floral tissue resources for any individual *O. nigricornis*. For this reason, pollination services

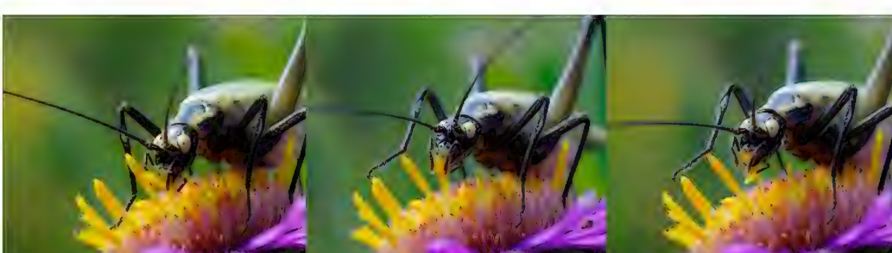


FIGURE 1. Three images demonstrating *O. nigricornis* feeding behaviour on *S. novae-angliae* florets; the images show the *O. nigricornis* individual manipulating a floret with its palps; note the stub of a previously-grazed floret under its head, evident in all three images (flower #1).

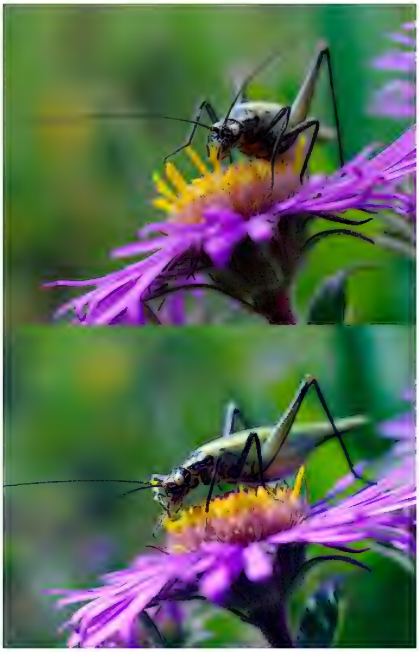


FIGURE 2. Two images demonstrating *O. nigricornis* feeding behaviour on *S. novae-angliae* (Asteraceae) florets. Top: the *O. nigricornis* individual beginning to feed on a flower head. Bottom: after a few minutes of *O. nigricornis* floral tissue herbivory, all but one open, perfect floret has been grazed (flower #1).

FIGURE 3. The *O. nigricornis* individual grazing on open florets of a *S. novae-angliae* (Asteraceae) flower head; note the discarded floral tissue in the foreground of the image (flower #2).

FIGURE 4. The *O. nigricornis* individual grooming its antennae on the edge of a *S. novae-angliae* (Asteraceae) flower head; note the pollen remaining on head, antennae, and legs of the insect (flower #1).

are unlikely to be significant unless the floral tissue represents a main food source for the cricket. While the consumption of the open, perfect floret tissue could also limit the potential for cross-pollination, observed herbivory on these structures was not complete (one floret on the first head was left untouched).

Aside from the few direct observations of feeding behaviour in the primary literature, *O. nigricornis* has documented associations with other plant genera and species, and it is possible that floral tissue feeding may occur in these cases as well. Adult *O. nigricornis* individuals have been observed in August and September on the branches or flowers of tall forbs, including *Solidago* spp. (Asteraceae), *Erigeron* sp. Linnaeus (Asteraceae), *Eupatorium* sp. Linnaeus (Asteraceae), and *Helianthus* sp. Linnaeus (Asteraceae), as well

as on trees and bushes (e.g. *Rubus* spp. Linnaeus [Rosaceae]) (Bruner 1895; Walker 1904; Blatchley 1920; Walker 1963; Vickery and Kevan 1986). While floral tissue herbivory has not been documented in these cases, *O. nigricornis* oviposit in the stems of some of these same species, including *Solidago* spp. (Asteraceae), *Helianthus* sp. (Asteraceae), and *Ambrosia* spp. Linnaeus (Asteraceae) (Bruner 1895; Blatchley 1920; Fulton 1926; Vickery and Kevan 1986). As Bruner (1895) highlights, oviposition into annual forb species, or perennial species whose above-ground stalks and stems die off, means that nymphs, which emerge in June or July (Vickery and Kevan 1986) may not emerge in direct contact with living plant tissue. Further, as many of these forb species flower into August and September, the floral tissue of these plant species are unlikely to be an important food source for *O. nigricornis* nymphs, and more likely to be used by adults which appear through August and September (Vickery and Kevan 1986).

In addition to the associations reported in the primary literature, adult *O. nigricornis* have been photographed on the floral tissue of 10 genera of plants in Canada and the USA, most from the family Asteraceae (Table 1). Out of 123 total *O. nigricornis* individuals posted to the iNaturalist and BugGuide websites (https://www.inaturalist.org/ and https://bugguide.net/node/view/15740, respectively) from Canada and the USA, 16 were photographed on active (pistils and/or stamens present), non-senescent floral tissue (Table 1). Although the resolution, zoom, and angle of photos on these websites do not allow for positive confirmation of floral herbivory, floral herbivory was deemed likely in three cases; two on *Helianthus* spp. (Asteraceae) flowers and one on *Symphyotrichum lanceolatum* (Willdenow) G.L. Nesom (Asteraceae). No other examples of floral tissue herbivory on *S. novae-angliae* (Asteraceae) have been recorded on either BugGuide or iNaturalist. Aside from these cases, for both the historical and photograph-based observations, it is important to note that, while floral tissue herbivory may be the reason for *O. nigricornis* presence, the individuals recorded may be using the plants in question for oviposition, calling, resting, or hunting, and further investigation will be necessary to determine the exact nature of these associations.

As *O. nigricornis* has now been confirmed to consume the floral parts of three plant species in different families; *Daucus carota* (Apiaceae) (Fulton 1915), *Agalinis auriculata* (Orobanchaceae) (Mulvaney *et al.* 2006), and *Symphyotrichum novae-angliae* (Asteraceae) (this work), in New York, Illinois, and Ontario, respectively, we can reasonably expect that floral tissue herbivory by *O. nigricornis* may extend to other members of these plant families. Observations from BugGuide and iNaturalist also support this supposition. It is also likely that other plant families, including those that the species used for oviposition, may also be consumed. In such cases the conditions for successful pollination may be met. Future investigation may reveal the specific trade-offs between potential incidental pollination by *O. nigricornis* and loss of floral tissue.

Acknowledgements

I would like to thank to Nigel Finney at Conservation Halton and Dr. Stephen Murphy at the University of Waterloo for facilitating my work in the Glenorchy Conservation Area. I would also like to thank journal editor Chris MacQuarrie, copyeditor Thomas

Onuferko, and two anonymous reviewers for their valuable comments and suggestions. This work was supported in part by the Natural Science and Engineering Research Council of Canada through the Vanier Canada Graduate Scholarship program.

TABLE 1: *Oecanthus nigricornis* individuals photographed on floral tissue, reviewed from all observations made in Canada and the USA; photos sourced from the BugGuide (BG) and iNaturalist (iNat) websites. For each observation, the year of observation; genus and family of the plant; province/state; website source; photo number (from the source); contributor ID; and whether or not floral herbivory was evident in the photo is noted.

Year	Flower genus/ species	Province/ State	Source	Photo #	Contributor ID	Floral herbivory evident in photo?
2015	*Tanacetum* L. (Asteraceae)	NB	BG	1139177	Brian Stone	Possible
2013	*Solidago* L. (Asteraceae)	PA	BG	846603	Kenneth Frank	Possible
2013	*Solidago* (Asteraceae)	OH	BG	837784	William Hull	Possible
2012	*Setaria* P. Beauv. (Poaceae)	NJ	BG	703647	Yurika Alexander	No
2012	*Ammophila* Host (Poaceae)	NB	BG	691179	Stuart Tingley	Possible
2010	*Verbesina* L. (Asteraceae)	WV	BG	471798	Stephen Cresswell	Possible
2007	*Solidago* (Asteraceae)	ON	BG	152052	imarsman	Possible
2006	*Eutrochium* Raf. (Asteraceae)	MA	BG	77558	Bill Claff	Possible
2017	*Solidago* (Asteraceae)	ON	iNat	8379218	alysonkarson	Possible
2017	*Solidago* (Asteraceae)	NY	iNat	9476228	jasondombroskie	No
2017	*Helianthus* L. (Asteraceae)	IL	iNat	11852805	psweet	Likely; pollen visible on mandibles, front legs, antennae
2017	*Symphyotrichum lanceolatum* (Willd.) G.L. Nesom (Asteraceae)	NY	iNat	8153233	arianawalczyk	Likely
2017	*Solidago* (Asteraceae)	NY	iNat	7864242	edgarallenhoopoe	No
2016	*Heliopsis* Pers. (Asteraceae)	WI	iNat	4105212	zachary25	Possible
2015	*Ageratina* Spach (Asteraceae)	OH	iNat	1918983	rcurtis	No
2014	*Helianthus* (Asteraceae)	OH	iNat	880144	acryptozoo	Likely; pollen visible on mandibles, front legs, antennae

References

Bell, P. D. 1979. Rearing the black horned tree cricket, *Oecanthus nigricornis* (Orthoptera: Gyllidae). *The Canadian Entomologist*, **111**: 709–712. doi: 10.4039/Ent111709-6.

Blatchley, W. S. 1920. *Orthoptera of Northeastern America, with Especial Reference to the Faunas of Indiana and Florida*. The Nature Publishing Company, Indianapolis, Indiana, United States of America. doi: 10.5962/bhl.title.1700.

Brown, W. D. 2008. Size-biased mating in both sexes of the black-horned tree cricket, *Oecanthus nigricornis* Walker (Orthoptera: Gryllidae: Oecanthinae). *Journal of Insect Behavior*, **21**: 130–142. doi: 10.1007/s10905-007-9112-1.

Brown, W. D., and Kuns, M. M. 2000. Female choice and the consistency of courtship feeding in black-horned tree crickets *Oecanthus nigricornis* Walker (Orthoptera: Gryllidae: Oecanthinae). *Ethology*, **106**: 543–557. doi: 10.1046/j.1439-0310.2000.00569.x.

Bruner, L. 1895. Insect enemies of the grape vine. *Nebraska State Horticultural Report*: 68–162.

Bussière, L. F., Basit, H. A., and Gwynne, D. T. 2005. Preferred males are not always good providers: female choice and male investment in tree crickets. *Behavioral Ecology*, **16**: 223–231. doi: 10.1093/beheco/arh156.

Chmielewski, J. G., and Semple J. C. 2003. The biology of Canadian weeds. 125. *Symphyotrichum ericoides* (L.) Nesom (*Aster ericoides* L.) and *S. novae-angliae* (L.) Nesom (*A. novae-angliae* L.). *Canadian Journal of Plant Science*, **83**: 1017–1037. doi: 10.4141/P01-179.

Coome, L. A. 2016. Nutritionally deprived black-horned tree cricket (*Oecanthus nigricornis*) consumes own spermatophore after failed mating. *Archives of Sexual Behavior*, **45**: 1023–1025. doi: 10.1007/s10508-016-0760-0.

Fulton, B. B. 1915. The tree crickets of New York: life history and bionomics. *New York Agricultural Experiment Station Technical Bulletin*, **42**: 3–47.

Fulton, B. B. 1926. Geographic variations in the *nigricornis* group of *Oecanthus* (Orthoptera). *Iowa State College Journal of Science*, **1**: 43–62.

Mulvaney, C. R., Molano-Flores, B., and Whitman, D. W. 2006. Is insect herbivory contributing to the threatened status of *Agalinis auriculata* (Orobanchaceae) in Illinois? *The Journal of the Torrey Botanical Society*, **133**: 560–565. doi: 10.3159/1095-5674(2006)133[560:IIHCTT]2.0.CO;2.

Swan, L. A., and Papp, C. S. 1972. *The Common Insects of North America*. Harper and Row, New York, New York, United States of America.

Vickery, V. R. and Kevan, D. K. McE. 1986. The grasshoppers, crickets, and related insects of Canada and adjacent regions: Ulonata: Dermaptera, Cheleutoptera, Notoptera, Dictuoptera, Grylloptera, and Orthoptera. *Insects and Arachnids of Canada Handbook Series*, **14**: 268–269.

Walker, E. M. 1904. The Crickets of Ontario. *Canadian Entomologist*, **36**: 249–255. doi: 10.4039/Ent36249-9.

Walker, T. J. 1963. The taxonomy and calling songs of the United States tree crickets (Orthoptera: Gryllidae: Oecanthinae). II. The *nigricornis* group of the genus *Oecanthus*. *Annals of the Entomological Society of America*, **56**: 772–789. doi: 10.1093/aesa/55.3.303.

PYRRHOCORIS APTERUS L. (HEMIPTERA: PYRRHOCORIDAE), A NEWLY INTRODUCED FAMILY, GENUS, AND SPECIES TO ONTARIO AND CANADA

P. J. OVIEDO ROJAS[1*] AND M. D. JACKSON[1]

[1]University of Guelph: 50 Stone Road East,
Guelph, Ontario, Canada N1G 2W1
email, poviedorojas@gmail.com

Scientific Note *J. ent. Soc. Ont.* 149: 27–32

The family Pyrrhocoridae (Hemiptera: Pentatomomorpha) has a widespread range, having its greatest diversity in the tropics yet also containing members endemic to the Holarctic region (Schuh and Slater 1995), although none are native to Canada. *Dysdercus* Guérin-Méneville (Hemiptera: Pyrrhocoridae), which includes the economically important cotton stainers, is the only pyrrhocorid genus with members native to the New World, but is chiefly tropical and more diverse in the Old World (Schaefer 2015). One species has been recorded from as far north as South Carolina and Georgia, USA (Henry 1988a). *Pyrrhocoris apterus* L. (Hemiptera: Pyrrhocoridae), commonly known as the European firebug, linden bug, or red soldier bug, is found natively throughout Europe and neighbouring regions of Asia. *Pyrrhocoris apterus* has also been recorded historically from Costa Rica (Distant 1880–1893) and reported in New Jersey, USA in 1896 (Barber 1911; Henry 1988a), though it was not considered established in North America until it was found in Utah, USA in 2008 (Hodgson 2008). This paper will describe the first account of *P. apterus*, and the family Pyrrhocoridae, in Canada, with evidence that the species has become locally established.

The first author first noticed *P. apterus* in a backyard in Etobicoke, Ontario near the intersection of Martin Grove Road and The Westway (43°41'N 79°34'W) in August 2017. An adult was photographed on 13 August 2017 (Fig. 1) and a nymph was photographed on 30 August 2017 (Fig. 2). While they were identified as *P. apterus* at that time, their importance was not noted until early 2018, when these photographs were submitted to the citizen science project iNaturalist (https://www.inaturalist.org/). It was then realized that these records would be the first in Canada.

To determine whether the population had established in the area, the leaf litter surrounding potential host plants on the property was searched for overwintering adults (Hodek 1968). Several live specimens were collected on 3 March 2018 and 5 March 2018 under leaf litter near perennial roses of Sharon (*Hibiscus syriacus* L., Malvaceae), and under leaf litter where an annual mallow (*Malva sylvestris* L., Malvaceae) grew the previous year. Overwintering adults were photographed on 23 March 2018 (Fig. 3), and a more thorough

Published September 2018

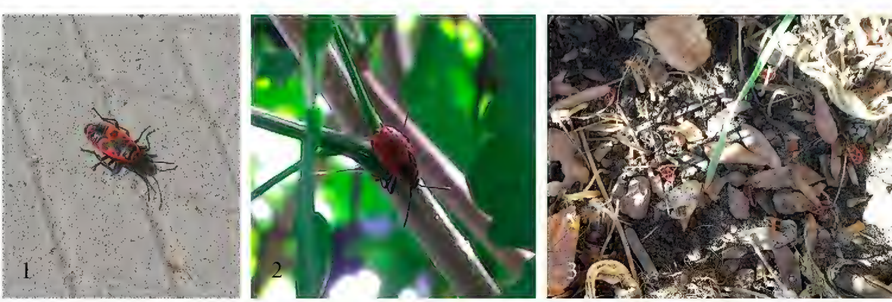
* Author to whom all correspondence should be addressed.

search through the leaf litter (within 10 m of the aforementioned host plants) on 25 March 2018 yielded dozens of adults, roughly equal numbers of males and females. Several mating pairs were also observed at this time. A series of *P. apterus* specimens were deposited at the University of Guelph Insect Collection (DEBU; accession numbers debu00398100–145, debu00398146–153). Separate observations of *P. apterus* were made in the Etobicoke area in July 2018 (A. Guidotti, pers. comm., Royal Ontario Museum).

How the species was introduced to Ontario is unknown, but it likely arrived along with imported plant material or soil. The reported locality is less than 3 kilometres east of Lester B. Pearson International Airport—a possible introductory route. The species was likely attracted to the neighbourhood due to an abundance of mallow plants, and it can be noted that both *H. syriacus* and *M. sylvestris* are introduced ornamentals from Europe and known host plants of *P. apterus* (Kristenová et al. 2011). Linden seeds (including *Tilia cordata* Mill. and *Tilia platyphyllos* Scop.), which also belong to the family Malvaceae, are one of their primary food sources in Central Europe (Kristenová et al. 2011), and this may enable them to feed on related Ontario species such as basswood (*Tilia americana* L.). Additionally, *P. apterus* is known to adapt to other seed diets even outside of Malvaceae, allowing it to easily colonize new areas (Kristenová et al. 2011).

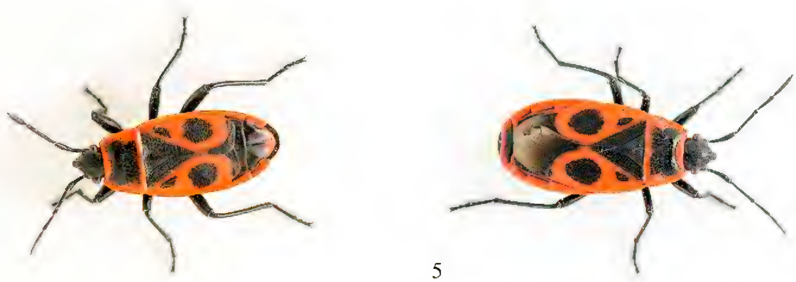
The host versatility of *P. apterus* makes them easy to rear, which has facilitated their use in research. In fact, the species has been implicated in the discovery of sex chromosomes (Henking 1891), as well as “paper factor” (Sláma and Williams 1965), the first plant-based juvenile hormone analog discovered (Williams 1970). Studies involving *P. apterus* span morphology, physiology, and genetics; hence, its habits and biology are well known (Socha 1993). So prominent is its use in research in its home range that it is depicted on the cover of the *European Journal of Entomology*. Arguably, its importance in entomological research is underappreciated outside of Europe.

Pyrrhocoris apterus is a distinctive hemipteran, typically having short red



FIGURES 1–3. *Pyrrhocoris apterus* individuals found *in situ*, 1. Adult male, 13 August 2017, (iNaturalist observation at https://www.inaturalist.org/observations/9958761); 2. Nymph on rose of Sharon (*H. syriacus*), 30 August 2017, (iNaturalist observation at https://www.inaturalist.org/observations/9860910); 3. Overwintering group of adults beneath leaf litter at the base of rose of Sharon (*H. syriacus*), 23 March 2018, (iNaturalist observation at https://www.inaturalist.org/observations/12519880).

wings with striking black markings (Fig. 4). While most individuals are brachypterous, a macropterous morph (Fig. 5) may develop under certain conditions, though neither morph is thought to fly (Socha 1993; Honěk 1995). *Pyrrhocoris apterus* (Fig. 6) is superficially similar to several species of Ontario Lygaeidae (such as the small milkweed bug, *Lygaeus kalmii* Stål (Fig. 7), and large milkweed bug, *Oncopeltus fasciatus* (Dallas)) and Rhopalidae (such as the box elder bug, *Boisea trivittata* (Say)), though Pyrrhocoroidea, including *P. apterus*, can be differentiated from most other Pentatomomorpha by the absence of ocelli (Henry 1997). Largidae, the sister group of Pyrrhocoridae, has yet to be recorded from Ontario, but has been recorded in northeastern USA (Henry 1988b). These two families can be differentiated by the lateral margins of the pronotum, being flattened and beveled in Pyrrhocoridae (Fig. 6) but rounded in Largidae (Fig. 8) (Schuh and Slater 1995). Within



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FIGURES 4–5. *Pyrrhocoris apterus* adults with typical markings, dorsal views, 4. Brachypterous male, 5. Macropterous female.

6 7 8

FIGURES 6–8. Select examples of North American Hemiptera, 6. *Pyrrhocoris apterus*, a member of Pyrrhocoridae, lacking ocelli and having a marginated pronotum, 7. *Lygaeus kalmii*, a member of Lygaeidae, with ocelli, 8. *Largus succinctus* (L.), a member of Largidae, lacking ocelli and having a pronotum with rounded edges.

Pyrrhocoridae, *P. apterus* may be confused with the visually similar *Scantius aegyptius* (L.), another Palearctic species that has been recently introduced to North America, though it has only been recorded in the state of California, USA (Bryant 2009). *Scantius aegyptius* is a winged pyrrhocorid with a more slender body shape, and may be definitively distinguished from *P. apterus* via the first segment of its rostrum, which is only about half the length of the head in *S. aegyptius* and about as long as the head in *P. apterus* (Pluot 1978). The lack of a black marking anterior to the large black spot on the hemelytron in *S. aegyptius* can also help differentiate it from *P. apterus*. The genus *Dysdercus*, the only lineage of Pyrrhocoridae native to the New World, is restricted to tropical and subtropical climes, and adults are easily differentiated from *Pyrrhocoris* by their dorsal colour patterning and parallel-sided abdomen. Nymphs can be more difficult to distinguish, but the gregariousness of *P. apterus* means nymphs can often be found in the vicinity of adults. *Pyrrhocoris apterus* nymphs are red with black wing buds and three black spots along the dorsal midline (Fig. 2).

As a Palearctic species, *P. apterus* has adaptations that allow it to survive cold winters like those that occur in southern Ontario. Adults are freeze-intolerant and can supercool their tissues to survive freezing temperatures, particularly under leaf litter (Koštál and Šimek 2000). Individuals enter diapause in the fall until they emerge in the spring, dependent on the photoperiod (Hodek 1968). Although the species is normally considered univoltine, warm temperatures can be conducive to a second brood in the summer of the same year (Hodek 1968; Saulich and Musolin 1996), yet individuals may prevent multiple generations by seeking out microhabitats that do not exceed 24°C, thereby restricting developmental rate (Honěk and Šrámková 1976). Nonetheless, as nymphs were observed in late August, the climate of southern Ontario is probably warm enough to allow for multivoltinism.

The impact of the introduction of *P. apterus* is currently unknown. *Pyrrhocoris apterus* could become a nuisance pest, as personal observations suggest that it can be extremely prolific locally, and their gregarious nature makes them difficult to ignore. Its dietary preference for seeds of mallows could have an impact on popular ornamental plants such as rose of Sharon (*H. syriacus*), but its potential impact on native *Hibiscus* species such as the swamp rose-mallow (*Hibiscus moscheutos* L.), recognized by the Species at Risk Act (SARA) and Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as a species of special concern (COSEWIC 2004), makes further study of *P. apterus* in Ontario important.

Considering the species' versatility and hardiness, it is unsurprising that it has become established in Ontario. Its flightlessness may limit its spread, but individuals may be transported unwittingly along with ornamental plants, soil, or even leaf litter. Nevertheless, they are conspicuous insects that can be easily noticed by the keen gardener, and with tools such as iNaturalist, amateur naturalists can assist in keeping track of their range and natural history.

Acknowledgements

A heartfelt thanks to Dr. Steven Paiero at the University of Guelph Insect Collection for his encouragement in writing this note. Specimen character photos were made possible

by NSERC funding awarded to Stephen A. Marshall (University of Guelph). Thank you also to the users of iNaturalist, including Lisa Thompson at the Natural History Museum of Utah, who supported the identification of the original *P. apterus* observations.

References

Barber, H.G. 1911. *Pyrrhocoris apterus* Linn. in the United States. *Journal of the New York Entomological Society*, **19**: 111–112.

Bryant, P.J. 2009. Invasion of Southern California by the Palearctic pyrrhocorid *Scantius aegyptius* (Hemiptera: Heteroptera: Pyrrhocoridae). *The Pan-Pacific Entomologist*, **84**: 190–193. doi: 10.3956/2009-27.1.

COSEWIC. 2004. COSEWIC assessment and update status report on the Swamp Rose-mallow *Hibiscus moscheutos* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 50 pp.

Distant, W.L. 1880–1893. Insecta. Rhynchota. Hemiptera-Heteroptera. Vol. I. Pyrrhocoridae. Pp. 220–234 In Godman, F.D. and Salvin, O. (eds.). 1915. Biologia Centrali-Americana: zoology, botany and archaeology. R.H. Porter, London, England.

Henking, H. 1891. Untersuchungen über die ersten Entwicklungsvorgänge in den Eiern der Insekten. Über Spermatogenese und deren Beziehung zur Entwicklung bei *Pyrrhocoris apterus* L. *Zeitschrift für wissenschaftliche Zoologie*, **51**: 685–736.

Henry, T.J. 1988a. Family Pyrrhocoridae Fieber, 1860. Pp. 613–615 In Henry, T.J. and Froeschner, R.C. (eds.) Catalog of the Heteroptera or True Bugs, of Canada and the Continental United States. E.J. Brill Publishers, Leiden, Netherlands.

Henry, T.J. 1988b. Family Largidae Amyot and Serville, 1843. Pp. 159–165 In Henry, T.J. and Froeschner, R.C. (eds.) Catalog of the Heteroptera or True Bugs, of Canada and the Continental United States. E.J. Brill Publishers, Leiden, Netherlands.

Henry, T.J. 1997. Phylogenetic analysis of family groups within the infraorder Pentatomomorpha (Hemiptera: Heteroptera), with emphasis on the Lygaeoidea. *Annals of the Entomological Society of America*, **90**: 275–301. doi: 10.1093/aesa/90.3.275.

Hodek, I. 1968. Diapause in females of *Pyrrhocoris apterus* L. (Heteroptera). *Acta Entomologica Bohemoslovaca*, **65**: 422–435.

Hodgson, E.W. 2008. “Utah Pests Fact Sheet: Red fire bugs”. Utah State University Extension and Utah Plant Pest Diagnostic Laboratory. http://extension.usu.edu/files/publications/factsheet/red-fire-bug08.pdf (accessed March 9, 2018).

Honěk, A. 1995. Factors and consequences of a non-functional alary polymorphism in *Pyrrhocoris apterus* (Heteroptera: Pyrrhocoridae). *Researches on Population Ecology*, **37**: 111–118. doi: 10.1007/BF02515768.

Honěk, A. and Šrámková, K. 1976. Behavioral regulation of developmental cycle in *Pyrrhocoris apterus* L. (Heteroptera: Pyrrhocoridae). *Oecologia*, **24**: 277–281. doi: 10.1007/BF00345479.

Koštál, V. and Šimek, P. 2000. Overwintering strategy in *Pyrrhocoris apterus* (Heteroptera): the relations between life-cycle, chill tolerance and physiological adjustments.

Journal of Insect Physiology, **46**: 1321–1329. doi: 10.1016/S0022-1910(00)00056-1.

Kristenová, M., Exnerová, A., and Štys, P. 2011. Seed preferences of *Pyrrhocoris apterus* (Heteroptera: Pyrrhocoridae): Are there specialized trophic populations? *European Journal of Entomology*, **108**: 581–586. doi: 10.14411/eje.2011.075.

Pluot, D. 1978. Notes on *Scantius aegyptius*, Palearctic Hemiptera pyrrhocorid comparison with *Pyrrhocoris apterus*. *Annales de la Société Entomologique de France*. **14**: 703–713.

Saulich, A.K. and Musolin, D.L. 1996. Univoltinism and its regulation in some temperate true bugs (Heteroptera). *European Journal of Entomology*, **93**: 507–518.

Schaefer, C.W. 2015. Cotton Stainers (Pyrrhocoridae) and Bordered Plant Bugs (Largidae). Pp. 515–535 In Panizzi, A.R. and Grazia, J. (eds.) True Bugs (Heteroptera) of the Neotropics. Springer, Dordrecht, Netherlands.

Schuh, R.T. and Slater, J.A. 1995. Pyrrhocoridae. Pp. 270–271 In Schuh, R.T. and Slater, J.A. (eds.) True Bugs of the World (Hemiptera: Heteroptera): Classification and Natural History. Cornell University Press, Ithaca, NY, USA.

Sláma, K. and Williams, C.M. 1965. Juvenile hormone activity for the bug *Pyrrhocoris apterus*. *Proceedings of the National Academy of Sciences of the United States of America*, **54**: 411–414. doi: 10.1073/pnas.54.2.411.

Socha, R. 1993. *Pyrrhocoris apterus* (Heteroptera) – an experimental model species. *European Journal of Entomology*, **90**: 241–286.

Williams, C. M. 1970. Hormonal interactions between plants and insects. Pp. 103–132 In Sondheimer E. and Simeone, J.B. (eds) Chemical Ecology. Academic Press, New York, NY, USA.

A NEW SPECIES OF *PALAEONEURA* WATERHOUSE (HYMENOPTERA: MYMARIDAE) FROM CALIFORNIA, USA, WITH TAXONOMIC NOTES ON *PALAEONEURA SAGA* (GIRAULT) COMB. N.

S. V. TRIAPITSYN

Entomology Research Museum, Department of Entomology,
University of California, Riverside, California, 92521, USA
email, serguei.triapitsyn@ucr.edu

Abstract

J. ent. Soc. Ont. 149: 33–47

A new species of *Palaeoneura* Waterhouse, *P. markhoddlei* Triapitsyn sp. n. (Hymenoptera: Mymaridae), is described from California, USA. It belongs to the informal *kusnezovi* species group of *Palaeoneura* that corresponds to the former genus *Chaetomymar* Ogloblin. The female of the new species, which may not be native to North America, is characterized by a long, markedly exserted ovipositor. It is also known from Maui Island, Hawaiian Islands (USA: Hawaii) and possibly from Taiwan. *Polynema saga* (Girault) is transferred to *Palaeoneura* as *Palaeoneura saga* (Girault) comb. n., and the male is described based on specimens from California and Nevada. The subgenus *Barypolynema* (*Tarphypolynema*) Ogloblin syn. n., of which *Anagrus saga* Girault is the type species, is removed from the previous synonymy under *Polynema* Haliday and its nominate subgenus *P.* (*Polynema*) and is instead synonymized under *Palaeoneura*. A key to females of the four described species of *Palaeoneura* in the New World is provided.

Published November 2018

Introduction

The genus *Palaeoneura* Waterhouse was redescribed and discussed by Triapitsyn and Berezovskiy (2007) who indicated its presence in the Neotropical region and mentioned the occurrence of several undescribed species there. Triapitsyn and Aquino (2010) reported *Palaeoneura* also from the Nearctic region, with two named representatives from eastern USA, *P. mymaripennis* (Dozier) and *P. durwest* Triapitsyn, and also mentioned one female specimen of an undetermined (and presumably non-native, likely unintentionally introduced) species in California, USA. Two additional females of this *Palaeoneura* species were more recently collected in San Diego County, California, allowing for its proper description and illustration.

Currently 51 species (including the two taxa added to the genus herein) are recognized in *Palaeoneura*, most of which were listed in Triapitsyn and Berezovskiy (2007), and later complemented by Huber (2009) and Triapitsyn and Aquino (2010). Diagnoses of

the entire genus were given in Triapitsyn and Berezovskiy (2007), Lin *et al.* (2007), Huber (2009), and Triapitsyn and Aquino (2010).

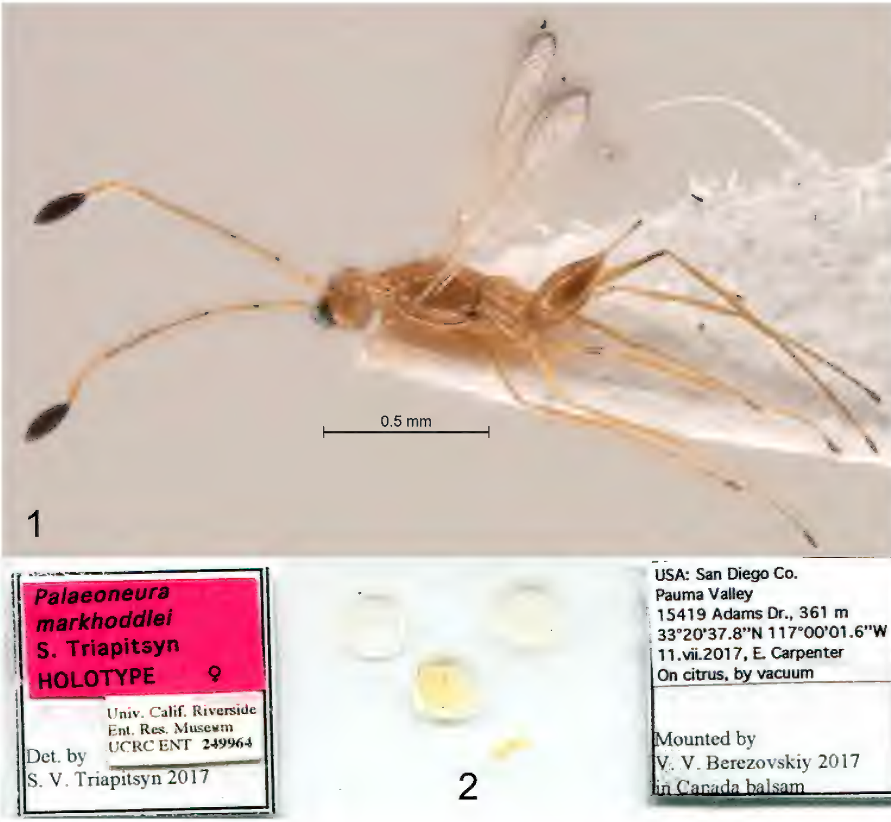
Triapitsyn and Berezovskiy (2007) mentioned, without naming them or providing either a key or detailed diagnoses, four informal, rather vaguely defined, intuitive species groups within *Palaeoneura*. Here, following Amer & Zeya (2018), the first of them is called the informal *kusnezovi* species group, which corresponds to the former genus *Chaetomymar* Ogloblin synonymized by Triapitsyn and Berezovskiy (2007) under *Palaeoneura*. It is currently the only species group of the genus that is well defined and easily recognizable. Its diagnosis is the same as that provided by Huber (2003) for *Chaetomymar* except the clava of the female antenna can bear either 6 or 7 multiporous plate sensilla. It is characterized by a very strong axillar seta (particularly wide basally, best seen in lateral view), which is also very long, often extending to the posterior margin of the scutellum (Fig. 5). More recently, Amer & Zeya (2018) gave a brief diagnosis of the *P. kusnezovi* species group and also included *P. unimaculatum* (Hayat and Anis) in it, which is probably incorrect based on the taxonomic notes provided by Triapitsyn and Berezovskiy (2007). Naming and defining other species groups is well beyond the scope of this study and would require a thorough worldwide revision of *Palaeoneura*, which is a speciose (particularly so in the Australasian region) and taxonomically difficult, poorly known genus.

Materials and Methods

All three known specimens of the new species from California were collected in 80–95% ethanol. Two of them were later dried from ethanol using a critical point drier, and point-mounted. One of the two specimens from the same collecting event in 2017 was photographed (Fig. 1) and then dissected and slide-mounted in Canada balsam according to the techniques described by Huber (2015); it was selected as the holotype.

Terms for morphological features follow Gibson (1997). Abbreviations used in the description and key are: F = funicular segment of female or flagellar segment of male antenna; mps = multiporous plate sensillum or sensilla on the antennal flagellar segments (= longitudinal sensillum or sensilla or sensory ridge(s) of other authors). Measurements are given in micrometers (µm) as length or, where appropriate (e.g., for the wings), as length: width ratios.

Abbreviations for the depositories of specimens are: BPBM, Bernice Pauahi Bishop Museum, Honolulu, Hawaii, USA; CNC, Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Ontario, Canada; EMEC, Essig Museum of Entomology, University of California, Berkeley, California, USA; MNHN, Muséum national d'Histoire naturelle, Paris, France; TARI, Taiwan Agricultural Research Institute, Wufeng, Taichung, Taiwan, Republic of China; UCDC, R. M. Bohart Museum of Entomology, University of California, Davis, California, USA; UCRC, Entomology Research Museum, University of California, Riverside, California, USA; USNM, National Museum of Natural History, Washington, District of Columbia, USA.



FIGURES 1–2. *Palaeoneura markhoddlei* Triapitsyn sp. n., female (holotype): 1, habitus of the dry, point-mounted specimen prior to slide-mounting; 2, holotype slide.

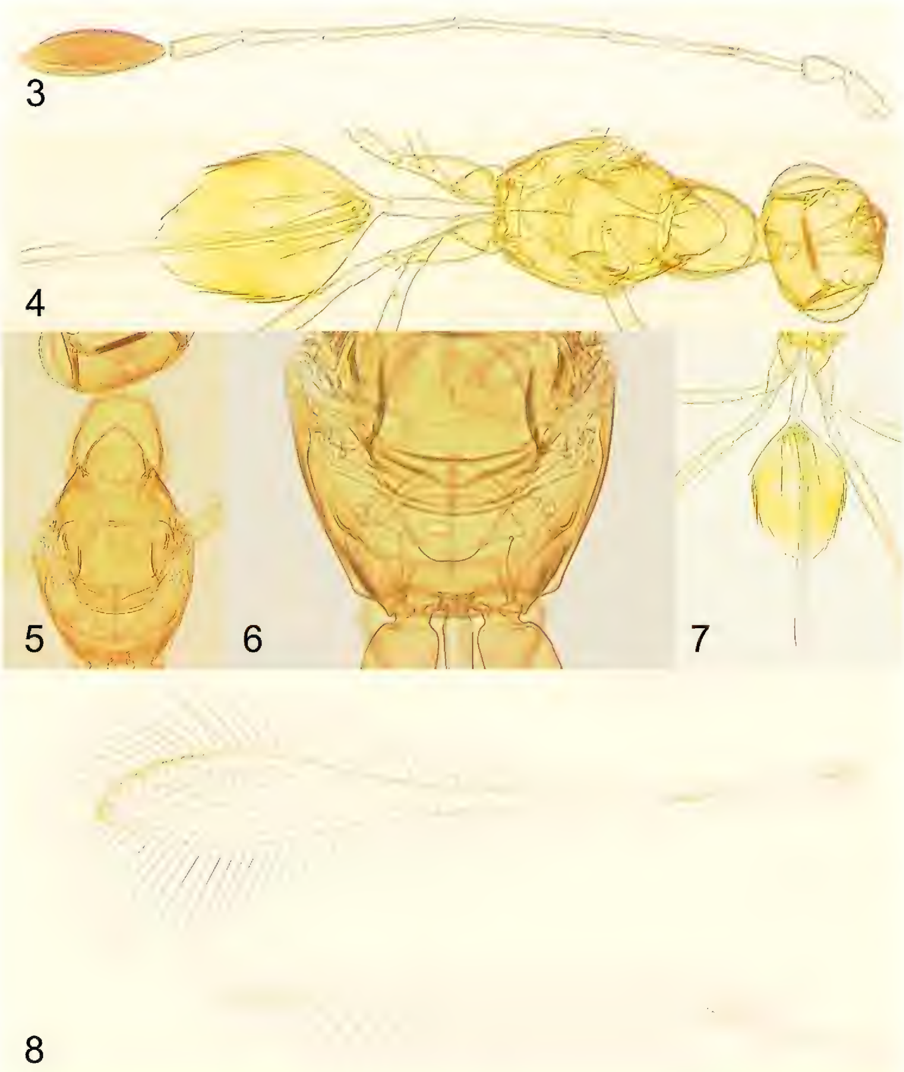
Taxonomy

Genus *Palaeoneura* Waterhouse, 1915

Palaeoneura Waterhouse 1915: 537–538. Type species: *P. interrupta* Waterhouse, designated by Gahan and Fagan 1923: 103.

Chaetomymar Ogloblin 1946: 277. Type species: *C. kusnezovi* Ogloblin, by original designation. Synonymized under *Palaeoneura* by Triapitsyn and Berezovskiy 2007: 38.

Barypolynema (*Tarphypolynema*) Ogloblin 1960: 79. Type species: *Anagrus saga* Girault, by original designation [as *Barypolynema* (*Tarphypolynema*) *saga* (Girault)] (from the previous synonymy under *Polynema* Haliday and its nominate subgenus *P.* (*Polynema*) by Triapitsyn and Fidalgo 2006: 60). **Syn. n.**



FIGURES 3–8. *Palaeoneura markhoddlei* Triapitsyn sp. n., female (holotype): 3, antenna (length = 1,033 µm); 4, body (length = 1,002 µm); 5, mesosoma (length = 375 µm); 6, scutellum and propodeum (length = 197 µm); 7, metasoma (length without ovipositor = 479 µm); 8, fore (length = 999 µm) and hind (length = 843 µm) wings.

Acanthomymar Subba Rao 1970: 667–668. Type species: *A. nigrum* Subba Rao, by original designation. Synonymized under *Palaeoneura* by Triapitsyn and Berezovskiy 2007: 38 (from the previous synonymy under *Polynema* by Huber 2003: 80).

Chaetomymar Ogloblin: Triapitsyn and Berezovskiy 2002: 2–3 (taxonomic history, comments); Huber 2003: 78–81 (taxonomic history, diagnosis, key to species, etc.).

Palaeoneura Waterhouse: Triapitsyn and Berezovskiy 2007: 39–42 (taxonomic history, synonymy, redescription, diagnosis, host associations, distribution, list of species, and notes on four unnamed, informal species groups), 63 (key to the Australian *Polynema* group genera); Lin *et al.* 2007: 40–43 (list of synonyms, diagnosis, distribution, hosts, list of Australian species); Huber 2009: 21 (brief diagnosis); Triapitsyn and Aquino 2010: 68–69 (list of synonyms, diagnosis, distribution, hosts, comments).

Key to the described species of *Palaeoneura* in the New World, females

1 Axillar seta very strong (particularly wide basally, best seen in lateral view), long, extending at least to posterior margin of scutellum (Fig. 5) (*P. kusnezovi* species group); body mostly yellow (Fig. 1).................... ***P. markhoddlei*** Triapitsyn, sp. n.

– Axillar seta relatively weak, not extending to posterior margin of scutellum (at most extending almost to frenal line); body (excluding petiole) mostly brown or dark brown..2

2(1) F2 shorter than pedicel (Fig. 11).................................... ***P. saga*** (Girault), comb. n.

– F2 longer than pedicel 3

3(2) Clava with 5 mps; F1 about half length of pedicel (or just slightly longer)............. ....***P. mymaripennis*** (Dozier)

– Clava with 6 mps; F1 about as long as pedicel ....***P. durwest*** Triapitsyn

Palaeoneura markhoddlei **Triapitsyn, sp. n.**

urn:lsid:zoobank.org:pub:95EF800A-8A9D-40B0-BDF6-CF5C3AFC6287
(Figs 1–8)

Palaeoneura sp.: Triapitsyn and Aquino 2010: 61–62, 69 (as a likely undescribed species).

Type material.

Holotype female, deposited in UCRC, on slide (Fig. 2) labeled: 1. "USA: [California – missing information] San Diego Co. Pauma Valley 15419 Adams Dr., 361 m 33°20'37.8"N 117°00'01.6"W 11.vii.2017, E. Carpenter On citrus, by vacuum", 2. "Mounted by V. V. Berezovskiy 2017 in Canada balsam", 3. [magenta] "*Palaeoneura markhoddlei* S. Triapitsyn HOLOTYPE ♀", 4. "Det. by S. V. Triapitsyn 2017", 5. [database label] "Univ. Calif. Riverside Ent. Res. Museum UCRC ENT 249964". The holotype (Figs 3–8) is in good condition, complete, dissected under 3 coverslips.

Paratypes: USA, California, San Diego Co.: Pauma Valley, 15419 Adams Dr., 33°20'37.8"N 117°00'01.6"W, 361 m, 11.vii.2017, E. Carpenter (on citrus, by vacuum) [1 female in 95% ethanol in a freezer, UCRC]. San Marcos, Deer Springs Ranch, 33°11'18.5"N 117°07'53.2"W, 423 m, 15.iii.2006, M. S. Hoddle (on avocado) [1 female on point, UCRC].

Non-type material examined. Hawaiian Islands (USA: Hawaii), Maui Island, Kahakuloa, 20°59'45.00"N 156°32'46.61"W, 38 m, 2–16.iii.2018, W. D. Perreira, yellow sticky board trap [1 female on point, BPBM].

FIGURE 9. *Palaeoneura* sp., female (Taipei City, Taiwan): habitus (length = 990 μm).

FIGURES 10–14. *Palaeoneura saga* (Girault) comb. n., female (holotype of *Anagrus saga* Girault): 10, slide; 11, antenna (length = 307 µm); 12, mesosoma (length = 212 µm), petiole (length = 48 µm) and a pair of wings; 13, gaster (length = 218 µm); 14, fore wing (length = 482 µm).

Diagnosis. *Palaeoneura markhoddlei* sp. n. belongs to the *kusnezovi* species group, as defined above. In Huber (2003), it keys to the same couplet as *P. hishimoni* (Taguchi) and *P. tayalum* (Taguchi), both from Asia. It differs from *P. hishimoni* in having a very long, strongly exserted ovipositor (Figs 4, 7) and from *P. tayalum* (Taguchi 1975) by the lack of a crescent-shaped, transverse mps on the clava of the female antenna in addition to having a strongly exserted ovipositor. From the three other described species of *Palaeoneura* in the New World, it can be separated using the key above, updated from Triapitsyn and Aquino (2010).

Palaeoneura markhoddlei is very similar to, if not conspecific with, the two following specimens, mentioned as belonging to a new *Palaeoneura* sp. by Triapitsyn (2018): Taiwan (Republic of China): Taipei City, x.1972, K. S. Lin [1 female, TARI] (Fig. 9); Pingtung Co., Kenting National Park, Hengchun, Kueitzuchiao (as "Kuraru, Heng Chung" on the label), 22–29.v.1965, K. S. Lin [1 female, TARI]. However, F6 in these Taiwanese specimens is 3.0–3.1 × as long as wide and either slightly shorter than F1 or about as long as F1, and also the ovipositor is a little longer (543–576 µm), 1.5–1.6 × length of metatibia, and a little more exserted beyond the gastral apex (by 0.44–0.46 × own total length) than in the holotype of *P. markhoddlei*. Although these differences seem to be quite minor, it is not clear whether they are due to intraspecific or interspecific variability; the Taiwanese specimens may represent an undescribed species.

Description. FEMALE (holotype). Body (Figs 1, 4) and legs yellow except petiole and base of gaster lighter (pale yellow) and apex of metafemur and apical tarsomeres brown; scape and pedicel light yellow, funicle brownish yellow except bases of F2 and F3 brown, and clava black.

Vertex with sparse, short, light setae. Antenna (Fig. 3) with scape plus radicle 2.2 × as long as wide and smooth; pedicel shorter than F1, F3 the longest funicular segment, F4 a little longer than F2 and much longer than F5, F6 the widest funicular segment, a little longer than F1, 3.4 × as long as wide, and with 1 mps (all other funicular segments without mps); clava 3.0 × as long as wide, almost as long as combined length of two preceding segments, with 6 mps.

Mesosoma (Figs 5–6) typical for species of *Chaetomymar* as defined in Huber (2003). Fore wing (Fig. 8) 7.3 × as long as wide; marginal vein with 2 short dorsal macrochaetae; disc notably narrowing just beyond venation before gradually expanding apically and almost entirely hyaline but with a notable brownish tinge along apical margin and also along anterior margin subapically, bare behind and also just beyond venation and setose at its broadest part; the longest marginal seta 1.6 × greatest width of disc. Hind wing (Fig. 8) almost 47 × as long as wide; longest marginal seta 6.9 × greatest width of disc.

Metasoma (Fig. 7) with ovipositor occupying almost entire (0.93 ×) length of gaster, markedly exserted beyond gastral apex (by 0.38 × own total length); 1.35 × length of metatibia.

Measurements (holotype). Body: 840 (taken from dry-mounted specimen before slide-mounting) or 1,002 (slide-mounted specimen); head: 132 (taken from dry-mounted specimen before slide-mounting) or 153 (slide-mounted specimen); mesosoma: 375; petiole: 153; gaster: 326; ovipositor: 492. Antenna: scape plus radicle: 73; pedicel: 49; F1: 77; F2: 148; F3: 177; F4: 160; F5: 92; F6: 84; clava: 173. Fore wing: 999:129; longest marginal

seta: 209. Hind wing: 843:18; longest marginal seta: 124.

Variation. Body length of the dry-mounted paratype 920 µm, and of the non-type specimen from Maui Island, Hawaii, 990 µm.

MALE. Unknown.

Etymology. The species is named in honor of its first collector, Mark S. Hoddle, a dedicated contributor of numerous interesting specimens to the UCRC. The other two specimens of the type series from California were collected during a survey for his project.

Distribution. USA (California and Hawaii [Hawaiian Islands, Maui Island]). I also have seen numerous unmounted female specimens [BPBM] of *P. markhoddlei* collected by W. D. Perreira during 2018 using yellow sticky board traps on Maui Island, where it seems to be rather common in certain localities such as Iao Valley and at roadside of Hana Highway, Hawaii Route 360 (20°54'05"N 156°13'30"W). As noted by Triapitsyn and Aquino (2010), this species is most likely of exotic origin (likely accidentally introduced from the Old World, possibly from Asia, either directly or via the Hawaiian Islands, given its close similarity with the aforementioned specimens of a *Palaeoneura* sp. from Taiwan), as members of this informal group of *Palaeoneura* are not known to occur naturally in the New World: Yoshimoto (1990), at that time of his writing, mistakenly indicated the presence of *Chaetomymar* in Argentina, Brazil, Canada, and USA but did not provide illustrations or mention specimens examined to support this.

Hosts. Unknown, but based on the few known host associations of other described species of *Palaeoneura* belonging to the species classified previously in *Chaetomymar*, e.g., *P. sophoniae* (Huber), *P. markhoddlei* may also be an egg parasitoid of a leafhopper from the tribe Nirvanini Baker (Hemiptera: Cicadellidae: Evacanthinae), perhaps the invasive two-spotted leafhopper, *Sophonia orientalis* (Matsumura), which is an established pest in San Diego County of California (Alyokhin *et al.* 2001). Rearings from parasitized eggs of *S. orientalis* in southern California would confirm this; there are at present no reports of any known egg parasitoids of this leafhopper in continental USA.

Palaeoneura saga (Girault, 1911), comb. n.

(Figs 10–20)

Anagrus saga Girault 1911: 296–297, 298 (key). Type locality: Washington, District of Columbia, USA.

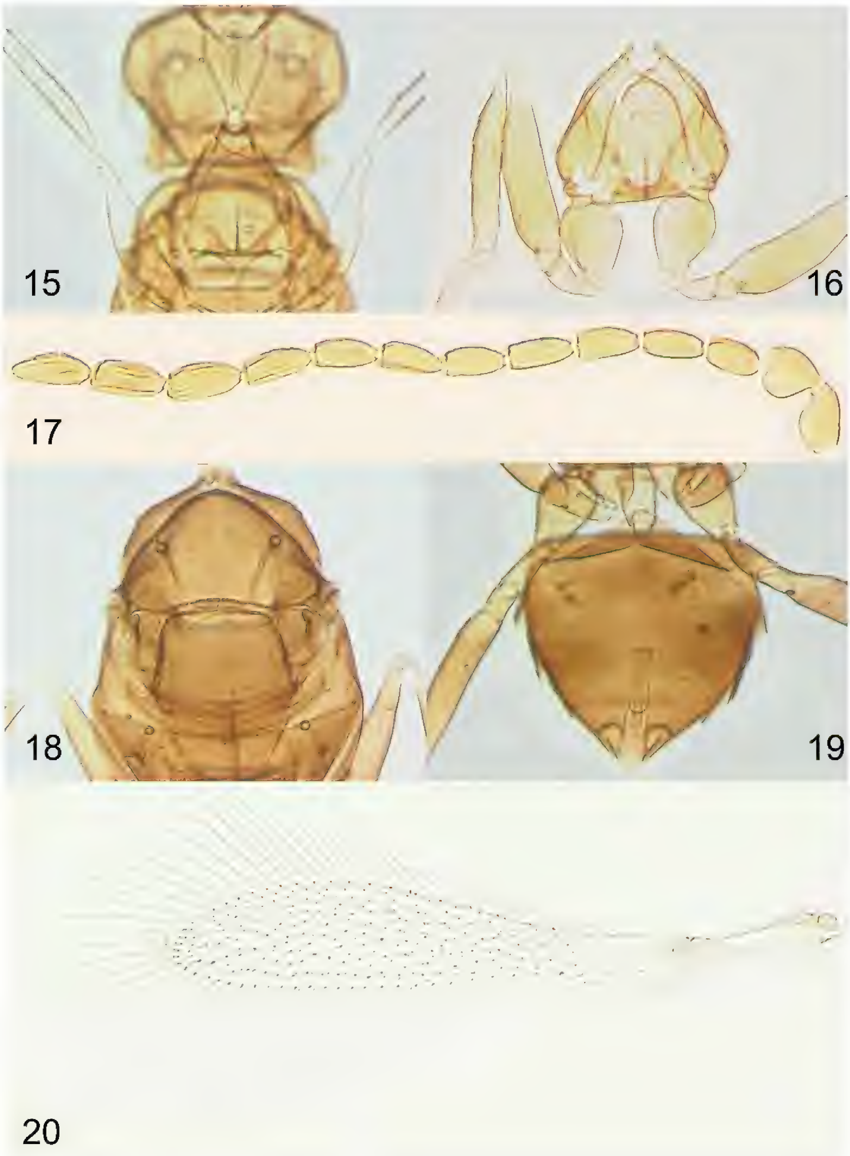
Polynema saga (Girault): Girault 1929: 17 (key); Harding 1930: 18–19 (biology); Yoshimoto 1990: 83 (list, unnecessary new combination); Wiesenborn 2002: 116–121 (host information, egg parasitism); Lin *et al.* 2007: 45 (tentatively recorded from Victoria, Australia), 99 (illustrations of female); Moya-Raygoza *et al.* 2012: 108–109 (distribution, host association).

Barypolynema saga (Girault): Ogloblin 1946: 285–287 (illustration); Peck 1963: 42 (catalog).

Barypolynema (*Tarphypolynema*) *saga* (Girault): Ogloblin 1960: 75 (illustration), 79 (diagnosis, host association, distribution); De Santis 1967: 112 (catalog).
Polynema (*Polynema*) *saga* (Girault): Triapitsyn and Fidalgo 2006: 60.

Type material examined. Holotype female [USNM] on slide (Fig. 10) labeled: 1. [the original label] "*Polynema* [(*Anagrus*) – crossed out] *saga* (Girault). *saga* Type ♀ 13812 [in pencil] USNM. Washington, DC. 31-7-05. H.S. Barber."; 2. [red] "*Polynema saga* Gir. Washington D.C. July 31, 1905. H.S. Barber Coll. Type No. 13812 U.S.N.M.". The holotype is poorly mounted and fragmented, as follows: two separate antennae, one fore wing, one hind wing, two fore legs, one hind leg, mesosoma with two middle and one hind legs, petiole, and one fore wing attached; head and gaster are in excess balsam not covered by the coverslip (Fig. 10).

Non-type material examined. Argentina, Mendoza, La Consulta, 33°44'S 69°07'W, INTA – Estación Experimental Agropecuaria La Consulta, 22–26.i.2007, S. Lanati [1 female, UCRC]. Australia, Victoria, Mitcham, i.1983, C. Lai (D. Yu) [2 females, 1 male, CNC]. Bermuda Islands, Bermuda Island, Southampton Parish, 4 Munro Lane, 22.v–22.vi.2001, J. and M. Munro [2 females, UCRC]. France, Gironde, Sainte Colombe (near Castillon-la-Bataille), 44°54'N 00°02'W, 13.viii.1998, M. van Helden [1 female, UCRC]. Hawaiian Islands, Oahu Island, Honolulu, 20.vii.1928, R. H. Van Zwaluwenburg ("ex. jassid eggs on *Tamarix aphylla*") [1 female, UCRC]. South Africa, Western Cape, Cape Town, Rosebank, x–xi.1960, D. P. Annecke [1 female, USNM] (determined by D. P. Annecke as *Polynema saga*). USA: Arizona, Coconino Co., Jct. of I40 and Matteo Rd., Crater Rd., 20–22.viii.1999, M. Yoder, E. Riley [10 females, TAMU (5), UCRC (5)]. California: Imperial Co., Algodones Dunes, Coachella Canal Road, 18.1 km NW of Glamis, 33°04'N 115°02'05"W, 30.v–3.vi.2008, Museum Survey Team [1 female, UCDC]. Los Angeles Co., San Pedro, 18.viii.2002, J. George [1 female, UCRC]. Riverside Co.: Lake Skinner (NE end), 33°36'07"N 117°02'05"W, J. D. Pinto: 7–21.v.1996 [1 female, UCRC]; 21.v–4.vi.1996 [1 male, UCRC]. Mecca, end of Ave. 62, 1.v.1986, M. S. Moratorio, W. White (on tamarisk) [1 female, UCRC]. Menifee Valley (hills on W end), 33°39'N 117°13'W, 1800', 1–20.vii.1980, J. Woolley, J. LaSalle, J. D. Pinto [1 female, UCRC]. Santa Rosa Plateau Reserve, PEET survey: 33°31'31"N 117°14'38"W, 17–18.vii.2001 [1 female, UCRC]; 33°31'32"N 117°14'45"W, 17–18.vii.2001 [1 female, UCRC]; 33°32'29"N 117°14'39"W: 18–23.vii.2001 [1 female, UCRC]; 23–30.vii.2001 [3 females, UCRC]. Stanislaus Co., Frank Raines Regional Park, Ranger Station, 37°25.294'N 121°22.666'W, 350 m, 20.viii–18.ix.2011, R. L. Zuparko [1 female, EMEC]. Yolo Co., Coyote Gulch, Experimental Ecosystem, 2 km SW of Davis, 24.ix–7.x.2001 [1 female, UCDC]. Kansas, Douglas Co., Lawrence, University of Kansas, summer of 1927, P. B. Lawson ("ex. eggs of *Euscelis stactogala*") [numerous females, USNM] (determined by A. B. Gahan as *Polynema saga* and by A. A. Ogloblin as *Barypolynema saga*). Nevada, Clark Co.: Boulder City, 30.vii.2001, W. D. Wiesenborn (from *Opsius stactogalus* Fieber eggs on *Tamarix ramosissima*) [1 male, UCRC]. Las Vegas, wash at Flamingo Rd., W. D. Wiesenborn (on *Tamarix ramosissima*): 2.vi.2003, [4 females, UCRC]; 16.vi.2003 [7 females, 1 male, UCRC]. Mesquite, W. D. Wiesenborn: 36°48'N 114°04'W, 20.v.2004 (on *Tamarix ramosissima*) [numerous females, UCRC]; 36°48'N 114°05'W, 24.vi.2004 (on *Tamarix*



FIGURES 15–20. *Palaeoneura saga* (Girault) comb. n. (16–19 – Lake Skinner, Riverside Co., California, USA; 15, 20 – Las Vegas, Clark Co., Nevada, USA): 15, female prosternum (length = 82 µm); 16, male prosternum (length = 103 µm); 17, male antenna (length = 612 µm); 18, male mesosoma (length = 242 µm); 19, male metasoma (length = 245 µm); 20, male fore wing (length = 504 µm).

ramosissima) [numerous females, UCRC]; 36°48'N 114°05'W, 16.vii.2004 [9 females, UCDC]; 36°48'N 114°05'W, 16.vii.2004 (on *Tamarix ramosissima*) [numerous females, UCRC]. Utah: Emery Co., Buckskin Spring (near Goblin Valley State Park), 26.viii.1981, E. E. Grissell [23 females, USNM]. Wayne Co., 2.5 mi. SE of Hanksville, 38°20'15"N 110°41'15"W, 1400 m, 26.vii.2004, J. D. Pinto [1 female, UCRC]. Vietnam, Ho Chi Minh City [as Saigon], 11.i.1950, J. Barbier [1 female, MNHN].

Redescription. FEMALE (holotype and non-type specimens). Body length (dry-mounted specimens) 500–630 µm. Body dark brown except petiole pale or yellowish; appendages brown except metacoxa, metatrochanter, and first three tarsomeres of all legs light brown. Antenna (Fig. 11) with scape smooth, 1.7–1.8 × as long as wide; pedicel 1.3–1.6 × as long as wide; all funicle segments short, much shorter than pedicel, and without mps; clava 2.5 × as long as wide, with 6 mps. Pronotum mediolongitudinally divided, propleura touching or almost touching each other anteriorly along midline, the prosternum thus "closed" anteriorly (Fig. 15); mesonotum smooth (Fig. 12); axillar seta fine and quite long, extending almost to frenal line on scutellum (as in Fig. 18); scutellar campaniform sensilla close to frenal line, frenal foveae absent; propodeum smooth, without carina. Fore wing (Figs 12, 14) 5.3–5.9 × as long as wide; marginal vein with 2 dorsal macrochaetae very close to each other; disc hyaline, setose behind and beyond venation; longest marginal seta 1.5–1.6 × greatest width of wing. Hind wing (Fig. 12) 21–22 × as long as wide; longest marginal seta 5.5–5.6 × greatest width of wing. Petiole a little dilated basally (Fig. 12), about 1.8 × as long as wide. Ovipositor occupying usually 0.8–0.9 × length of gaster (Fig. 13), at most just barely exserted beyond gastral apex; ovipositor about 1.1 × length of metatibia.

Measurements (holotype). Head: 70; mesosoma: 212; petiole: 48; gaster: 218; ovipositor: 200. Antenna: scape (excluding radicle): 52; pedicel: 39; F1: 18; F2: 22; F3: 17; F4: 23; F5: 18; F6: 27; clava: 91. Fore wing: 482:91; longest marginal seta: 136. Hind wing: 394:18; longest marginal seta: 100.

Description. MALE (non-type specimens from California and Nevada, USA). Body length (dry-mounted specimens) about 500 µm. Body dark brown except petiole light brown; appendages mostly brown. Antenna (Fig. 17) with scape minus radicle 1.8–2.0 × as long as wide; flagellomeres more or less subequal in length (F1 the shortest and F11 the longest). Prosternum (Fig. 16) as in female. Fore wing (Fig. 20) about 5.8 × as long as wide, longest marginal seta about 1.6 × greatest width of wing; hind wing about 25 × as long as wide, longest marginal seta about 5.8 × greatest width of wing. Genitalia (Fig. 20) without hooks on digiti.

Distribution. Australia (Victoria) (Lin *et al.* 2007 [as *Polynema saga*]), Bermuda Islands (new record), France (new record), USA, and Vietnam (new record), as well as Argentina, the Hawaiian Islands, Republic of South Africa (Ogloblin 1960 [as *Barypolynema* (*Tarphypolynema*) *saga*]), and Mexico (Moya-Raygoza *et al.* 2012 [as *Polynema saga*]).

This discovery of *P. saga* in France is a new record of *Palaeoneura* from Europe. Lin *et al.* (2007) reported this species from Australia based on one female from Mitcham, Victoria, which had been previously identified by me as *Polynema saga*, but not included in their list of the Australian species of *Polynema* until more Australian specimens had been

collected to confirm conclusively its presence there. However, there is no doubt whatsoever that the two females and one male from that locality indeed belong to *P. saga*; thus I confirm its presence in Australia.

Hosts. *Dalbulus maidis* (DeLong) (Moya-Raygoza *et al.* 2012) and *Opsius stactogalus* Fieber (Hemiptera: Cicadellidae) (Lawson 1929 [as *Euscelis stactogalus*]; Peck 1963; Wiesenborn 2002, 2005) (Hemiptera: Cicadellidae).

Comments. *Barypolynema* (*Tarphypolynema*) *saga* was placed by Triapitsyn and Fidalgo (2006) in *Polynema* Haliday and its nominate subgenus *P.* (*Polynema*). A careful examination of the better prepared slide-mounted specimens, which have only recently became available, prompted me to reconsider and, instead, place it in *Palaeoneura*. Its peculiar fore wing (Figs 14, 20), the "closed" propleura (Figs 15–16), and male genitalia (Fig. 20) without hooks on the digiti fit the latter genus better. Consequently, the subgenus *Barypolynema* (*Tarphypolynema*) Ogloblin, of which *Anagrus saga* Girault is the type species, is removed from the previous synonymy under *Polynema* and *P.* (*Polynema*) and synonymized under *Palaeoneura*.

Acknowledgements

I thank Mark S. Hoddle and Vincent Strode (Department of Entomology, University of California, Riverside, California, USA) for bringing my attention to these interesting specimens and donating them to the UCRC, Chi-Feng Lee (TARI) for the loan of specimens, and William D. Perreira for collecting and making available the specimens of *P. markhoddlei* from Maui Island, Hawaii, USA. The Dana Anne Yee and Atherton Family Foundations are acknowledged for funding W. D. Perreira's collecting in Maui; Annette Matsuda (State of Hawaii Department of Transportation) and John Smith (Maui County Department of Public Works) are thanked for allowing him to survey for insects along the roadside at Kahakuloa. Vladimir V. Berezovskiy (UCRC) mounted the specimens.

References

Alyokhin, A. V., Yang, P. and Messing, R. H. 2001. Distribution and parasitism of *Sophonia rufofascia* (Homoptera: Cicadellidae) eggs in Hawaii. *Annals of the Entomological Society of America*, **94**(5): 664–669. doi: 10.1603/0013-8746(2001)094[0664:DAPOSR]2.0.CO;2

Amer, F. S. K. and Zeya, S. B. 2018. Review of the Indian species of *Palaeoneura* Waterhouse (Hymenoptera: Mymaridae). *Oriental Insects*, 1–21. doi: 10.1080/00305316.2018.1478754

De Santis, L. 1967. *Catálogo de los himenópteros argentinos de la serie Parasítica, incluyendo Bethyloidea*. Comisión de Investigación Científica, Gobernación de la Provincia de Buenos Aires, La Plata.

Gahan, A. B. and Fagan, M. M. 1923. The type species of the genera of Chalcidoidea or Chalcid-flies. *Bulletin of the United States National Museum*, **124**: 1–173.

Gibson, G. A. P. 1997. Chapter 2. Morphology and terminology. Pp. 16–44 In Gibson, G. A. P., Huber, J. T. and Woolley, J. B. (eds.) Annotated keys to the genera of Nearctic Chalcidoidea (Hymenoptera). NRC Research Press, Ottawa, Ontario, Canada.

Girault, A. A. 1911. Descriptions of North American Mymaridae with synonymic and other notes on described genera and species. *Transactions of the American Entomological Society*, **37**: 253–324.

Girault, A. A. 1929. *North American Hymenoptera Mymaridae*. Privately printed, Brisbane.

Harding, L. 1930. The biology of *Opsius stactogalus* Fieber (Homoptera, Cicadellidae). *Journal of the Kansas Entomological Society*, **3**(1): 7–22.

Huber, J. T. 2003. Review of *Chaetomymar* Ogloblin, with description of a new species in the Hawaiian Islands (Hymenoptera: Mymaridae). *Journal of Hymenoptera Research*, **12**(1): 77–101.

Huber, J. T. 2009. Introduction to the Mymaridae (Hymenoptera) of Fiji, with description of two new species and comparison with the fairyflies of other Pacific Islands. (In Evenhuis, N. L. and Bickel, D. J. (eds.) *Fiji arthropods XV*). *Bishop Museum Occasional Papers*, **106**: 17–34.

Huber, J. T. 2015. World reclassification of the *Gonatocerus* group of genera (Hymenoptera: Mymaridae). *Zootaxa*, **3967**(1): 1–184. doi: 10.11646/zootaxa.3967.1.1

Lawson, P. B. 1929. A leafhopper parasite–*Polynema saga* (Girault). (Hymenoptera, Mymaridae). *Annals of the Entomological Society of America*, **22**(1): 130. doi: 10.1093/aesa/22.1.130

Lin, N.-Q., Huber, J. T. and La Salle, J. 2007. The Australian genera of Mymaridae (Hymenoptera: Chalcidoidea). *Zootaxa*, **1596**: 1–111.

Moya-Raygoza, G., Luft Albarracin, E. and Virla, E. G. 2012. Diversity of egg parasitoids attacking *Dalbulus maidis* (Hemiptera: Cicadellidae) populations at low and high elevation sites in Mexico and Argentina. *Florida Entomologist*, **95**(1): 105–112. doi: 10.1653/024.095.0117

Ogloblin, A. A. 1946. Description of new genera and species of Mymaridae (Hymenoptera: Chalcidoidea). *Iowa State College Journal of Science*, **20**(3): 277–295.

Ogloblin, A. 1960. Las especies nuevas del gén. *Barypolynema* A. Ogl. (Hymenoptera, Mymaridae). *Neotrópica*, **6**(21): 71–80.

Peck, O. 1963. A catalogue of the Nearctic Chalcidoidea (Insecta: Hymenoptera). *The Canadian Entomologist, Supplement*, **30**: 1–1092. doi: 10.4039/entm9530fv

Subba Rao, B. R. 1970 (1968). Descriptions of the genera and species of Mymaridae (Hymenoptera) from the Far East and the Ethiopian region. *Bulletin of Entomological Research*, **59**: 659–670. doi: 10.1017/S0007485300003655

Taguchi, H. 1975. Two new *Chaetomymar* species from Japan and Taiwan (Hymenoptera: Mymaridae). *Transactions of the Shikoku Entomological Society*, **12**(3–4): 111–114.

Triapitsyn, S. V. 2018. An annotated checklist of Mymaridae (Hymenoptera: Chalcidoidea) in Taiwan, with descriptions of five new species. *Journal of Taiwan Agricultural Research*, **67**(2): 113–165. doi: 10.6156/JTAR.201806_67(2).0002

Triapitsyn, S. V. and Aquino, D. A. 2010. On the occurrence of *Polynema* Haliday (*Dorypolynema* Hayat and Anis) and *Palaeoneura* Waterhouse (Hymenoptera: Mymaridae) in the New World, with description of two new species. *Acta Zoológica Lilloana*, **54**(1–2): 61–77.

Triapitsyn, S. V. and Berezovskiy, V. V. 2002. Review of the Mymaridae (Hymenoptera, Chalcidoidea) of Primorskii krai: genera *Chaetomymar* Ogloblin, *Himopolynema* Taguchi, and *Stephanodes* Enock. *Far Eastern Entomologist*, **110**: 1–11.

Triapitsyn, S. V. and Berezovskiy, V. V. 2007. Review of the Oriental and Australasian species of *Acmopolynema*, with taxonomic notes on *Palaeoneura* and *Xenopolynema* stat. rev. and description of a new genus (Hymenoptera: Mymaridae). *Zootaxa*, **1455**: 1–68.

Triapitsyn, S. V. and Fidalgo, P. 2006. Definition of *Doriclytus*, stat. rev. as a subgenus of *Polynema* and redescription of its type species, *P. (Doriclytus) vitripenne* (Hymenoptera: Mymaridae). *Zootaxa*, **1362**: 55–68.

Waterhouse, C. O. 1915. XX. Descriptions of two new genera, and new species of Mymaridae from Tasmania [with illustrations from photographs by F. Enock]. *The Transactions of the Entomological Society of London*, for the year 1915, parts III and IV: 536–539 + pl. XCII. doi: 10.1111/j.1365-2311.1915.tb02992.x

Wiesenborn, W. D. 2002. Weak dependence of *Polynema saga* (Girault) (Hymenoptera: Mymaridae) parasitism rate on *Opsius stactogalus* Fieber (Homoptera: Cicadellidae) egg density. *Journal of the Kansas Entomological Society*, **75**(2): 116–122.

Wiesenborn, W. D. 2005. Biomass of arthropod trophic levels on *Tamarix ramosissima* (Tamaricaceae) branches. *Environmental Entomology*, **34**(3): 656–663. doi: 10.1603/0046-225X-34.3.656

Yoshimoto, C. M. 1990. *A review of the genera of New World Mymaridae (Hymenoptera: Chalcidoidea)*. Flora and Fauna Handbook No. 7. Sandhill Crane Inc. Press, Gainesville, Florida.

POSTER AND PRESENTATION ABSTRACTS ENTOMOLOGICAL SOCIETY OF ONTARIO ANNUAL GENERAL MEETING

Bark Lake Leadership and Conference Centre, Irondale, Ontario, October 19–21, 2018

J. ent. Soc. Ont. 149: 49–62

Plenary abstract

Ontario's Insects – Assessment, monitoring and discovery in the digital age.
Jones, C.

Ontario has a long and rich history of entomological exploration and study. Many professional biologists and amateur naturalists have made significant contributions to our collective knowledge of Ontario's insect biodiversity. Such efforts have allowed us to begin the process of assessing the conservation status of many insect orders with some species being officially recognized as Species at Risk by the federal and/or provincial governments. Despite our long history of study and exploration, many insects are so poorly known that we have no clue as to their conservation status. With the advent of easy access digital photography, smart phone technology and natural history based social media platforms such as iNaturalist, this is all rapidly changing. Never before has it been so easy for citizen scientists of all calibers to work collectively with some of the world's leading taxonomic experts to make significant contributions to our understanding of insect distribution and status – if you haven't yet jumped on board, what are you waiting for!?!

Poster abstracts

Luna ID: Mobile applications for instant insect identification using machine learning and computer vision.
Blair, J.
jblair@uoguelph.ca

Luna ID is a University of Guelph student-operated project aiming to develop mobile apps for photo-identifying insects using machine learning and CNNs. Our apps will primarily serve agricultural, educational and medical purposes. Our objective is to provide our users with a product that is tailored to their specific need while providing accurate identifications within seconds. We already have multiple apps available on the Google Play Store and Apple App Store with photo identification accuracies of >95%. Here, we present an overview of the methods for photo recognition app development and explore future utilisation of CNNs for entomological purposes.

Published December 2018

Establishment of the moth *Hypena opulenta* in Canada: diapause induction and mass rearing methods to enable biocontrol of *Vincetoxicum* spp.

Bourchier, R.S., L.M. Seehausen, I.M. Jones*, and S.M. Smith.
**i.jones@utoronto.ca*

Hypena opulenta (Lepidoptera: Erebidae) was first released in Canada in 2013 for biocontrol of dog-strangling-vine (DSV). We developed artificial diets to facilitate year-round mass-rearing of *H. opulenta*. Furthermore, we investigated the factors that induce diapause in *H. opulenta,* to inform agent release strategy. We successfully reared moths on DSV-supplemented artificial diets. Laboratory trials revealed photoperiod to be the dominant factor for diapause induction, while staggered cage releases showed that only individuals released early in spring produced more than one generation. Our results indicate a narrow window for field releases in Ontario, if released individuals are to produce multiple generations.

Using native congeners as 'surrogates' to identify false-positives in host specificity testing.

deJonge, R.B., R. Bourchier, H. Hinz, G. Cortat, and S.M. Smith.

Insects' fundamental host-ranges, defined by host-range testing, are usually broader than their ecological host-ranges. Comparing host-testing results with the host-range of congeneric species can help to identify true ecological hosts from suspected false-positives. We compared the host-testing results of a potential European biocontrol agent, *Chrysochus asclepiadeus*, with the host-ranges of two North American (NA) congeners. During host-testing, *C. asclepiadeus* developed successfully on NA milkweeds. However, host-range comparisons revealed that *C. asclepiadeus* aligns most closely with *C. auratus*, a species that does not use milkweeds as ecological hosts. Therefore, additional field-testing of *C. asclepiadeus* on NA milkweeds in Europe is merited.

The impact of neonicotinoid pesticides on wild bees in an agricultural system.

Gaudreault, E.* and R. Sargent.
**emma.s.gaudreault@gmail.com*

Increasing concern about the impacts of systemic pesticides on bee health has been primarily focused on honeybees, which can encounter pesticides in nectar and pollen as they forage. Most native bees nest in the ground putting them at risk of exposure to pesticides through soil. Here I describe a study of ground nesting bees on Ontario farms. I am collecting data on wild bees, soil pesticide levels, floral resources, and soil impaction. Next summer I will also conduct an experimental study on reproduction and survival of ground nesting bees exposed to field realistic levels of neonicotinoids in the soil.

Not just another cute Chelicerate: De novo assembly of the Beringian pseudoscorpion (*Wyochernes asiaticus*) transcriptome reveals putative venom proteins.

Lebenzon, J.F.*, J. Toxopeus, S.E. Anthony, and B.J. Sinclair.
**jlebenzo@uwo.ca*

There are over 3000 described Pseudoscorpiones species, some inhabiting areas above the Arctic circle. Most research on pseudoscorpions has focused on species found at lower latitudes, and we therefore have a limited understanding of the biology of Arctic species. Here, we used RNA-seq to characterize the transcriptome of Beringian pseudoscorpions collected from the Yukon Territory. We identified hundreds of stress-related transcripts that may facilitate survival in the Arctic, and five groups of transcripts encoding arachnid and other arthropod venom proteins that have not previously been identified in pseudoscorpions. This transcriptome provides a basis for future work investigating the underlying biology of pseudoscorpions.

The contribution of invertebrates to the seasonal diets of walleye in Lake St. Joseph.

Ricker-Held A.*, D. Beresford, C. Wilson, and D. de Kerckhove.
**aydenrickerheld@trentu.ca*

Walleye (*Sander vitreus*) are ecologically and economically significant for recreational and commercial fisheries across Ontario. Walleye are effective piscivores, but their foraging behaviour on alternative prey is largely unknown. Angler anecdotal evidence suggests that walleye target insects such as Mayflies (Ephemeroptera). My research examines the diets of walleye from May to September on Lake St. Joseph in northern Ontario, to determine the role insectivory plays in seasonal foraging. I will identify stomach contents of mature fish through morphological analysis and eDNA methods. These results will inform long-term management strategies.

Habitat suitability and dispersal capacity of a newly introduced butterfly, *Polyommatus icarus*.

Rivest, S.A.* and H.M. Kharouba.
*University of Ottawa, Department of Biology, Ottawa, Ontario, K1N 6N5, Canada; *srive046@uottawa.ca*

The frequency of species introductions is on the rise globally. One newly introduced species of butterfly, the European Common Blue (*Polyommatus icarus*), is expanding its range around Montréal, QC, faster than expected. To determine the factors that will predict its range expansion in the future, we assessed the dispersal capacity of *P. icarus* and the local habitat characteristics that best predict its abundance. We found that *P. icarus* adults only rarely fly long distances (~900m) and that they are most abundant where there is less canopy cover, where their preferred larval foodplant is present, and where human-mediated disturbances are semi-frequent (every 1-3 yrs).

How does staphylinid abundance differ between field and forest?

Semenuk A.*, I. Ostovar, J. Alaimo, D. McIsaac, K. Belanger, S. Clout, and M.A. Smith.
**asemenuk@uoguelph.ca*

To answer this question we collected staphylinids from a small woodlot and adjacent field on the University of Guelph campus between 2011 and 2013 using a variety of trapping methods. Over this small spatial scale, we expected the relative abundance of staphylinid subfamilies to be uniform across the forest, field, and edge ecotones. However, only one (Aleocharinae) fit this pattern while three of the four subfamilies (Staphylininae, Oxytelinae, and Tachyporinae) were most abundant within the forest. Species-level analyses continue and we have identified many European adventives and one example of a new locality of a relatively new species of Aleocharinae.

A review of assisted colonization methods for butterfly conservation.

Sherin, L.M.*, G.W. Otis, and J.E. Linton.
**lsherin@uoguelph.ca*

There has been a decline in worldwide butterfly populations over the past century. Due to this decline, there has been an increase in conservation-driven captive-rearing programs. However, the documentation on butterfly assisted colonization programs remains largely decentralized, so it is difficult to assess the efficacy of captive-rearing over other colonization methods. By reviewing the literature and interviewing conservationists, we found that captive-rearing methods are expensive and often have a low success rate. We also found that the optimal life stage for butterfly release is often dependent on the species' specific life history. This information should better inform future efforts.

Do biological and environmental variables explain rates of molecular evolution in Caddisflies (Trichoptera)? A whole-tree approach.

Thompson I.*, J. May, and S. Adamowicz.
**ithomp01@uoguelph.ca*

Prior research has shown that rates of molecular evolution covary with biological traits in various taxa. However, few studies have assessed multiple traits, and many taxonomic groups remain to be investigated. By adapting an analysis pipeline in the R language previously tested on fish, this study investigated rates of evolution in mitochondrial DNA in Trichoptera. A variety of biological traits and environmental factors were tested as potential correlates of molecular rates. Ultimately, rates were not significantly explained by traits in a multivariable context, supporting the usage of mitochondrial DNA in Trichoptera for dating phylogenetic trees using molecular clock methods.

Distribution of Syrphidae (Diptera) across the far north of Ontario.

Vezsenyi, K.A.*, D.V. Beresford, W.J. Crins, J.A. Schaefer, and J.H. Skevington.
**kathrynvezsenyi@trentu.ca*

Hover flies (Syrphidae) are an important and diverse pollinator group whose distributions

are poorly known in the north. Here, we present the first comprehensive list of syrphids found in the Far North of Ontario, a highly under-sampled region due to its remote location. Sampling was conducted from 2009 to 2016, through projects such as the Far North Biodiversity project by the OMNRF. Traps used include Malaise, Nzi, pan traps, pitfall, bottle traps, and net sweeps. A total of 1514 individuals of 120 species were collected, 6 of which are new species records for Ontario.

Unusual distributions of solitary bees in Ontario's far north and Akimiski Island, Nunavut.
Vizza, K., D. Beresford, J. Schaefer, and J.S. MacIvor.

Bees are valuable pollinators in environments worldwide; the North is no exception. We surveyed Akimiski Island, one of Nunavut's most southern islands, where there is limited knowledge of biodiversity. We used morphology and DNA barcoding to identify bee species, assessed species richness as a function of the number of specimens (rarefaction) and true species diversity (Chao1) and compared the island to Ontario's continental Far North. We found 17 species on Akimiski Island and 24 in the Far North. While more species and more specimens were caught in the Far North, Akimiski Island had a slightly higher true species diversity than either ecozone alone.

Presentation abstracts

How does staphylinid abundance change along a neotropical elevation gradient?
Alaimo J.*, D. McIsaac, D.H. Janzen, W. Hallwachs, S.J. Dolson, and M.A Smith.
**jalaimo@uoguelph.ca*

The Area de Conservación Guanacaste (ACG) in northwestern Costa Rica contains a dry forest, rainforest, and cloud forest that are home to an amazing diversity of invertebrates. Across these forests, we used a decade's worth of collections to ask whether the abundance of staphylinid subfamilies changed along a 1500 m elevation gradient. Using the six most abundant staphylinid subfamilies collected, we found a band of highest abundance from each subfamily at the start of the high elevation cloud forest. While many species appear to have limited elevational ranges, we continue to examine species-level patterns of elevation and abundance.

Relating performance to fitness in Western black widow spiders (*Latrodectus hesperus*).
Anthony, S.E.*, C.E. Scott, and B.J. Sinclair.
**santho2@uwo.ca*

Many researchers infer the effects of temperature acclimation on fitness in ectotherms by measuring locomotion. However, this link between performance and fitness is rare. Our study measured the effect acclimation has on both thermal performance and mating success in Western black widow spiders. We found that acclimation to either 15°C or 25°C did not

yield a significant difference in thermal performance. We also noticed that those acclimated to lower temperatures were more likely to mate at high temperature than those with previous high temperature exposure, though not significantly. Therefore, performance may not be an appropriate proxy for fitness in ectotherms.

Effect of landscape disturbance on bee (Apoidea) abundance and diversity in the Niagara Region.

Audet, T.* and M. Richards.
**ta16gf@brocku.ca*

Ecosystem disturbance decreases the abundance and diversity of bees in the short term. Most research on disturbance has been on heavily disturbed or chronic disturbances, with less on moderate acute disruptions. We examined the impact of a short, moderate disturbance, mowing and shrub removal, on a bee community at Brock University. We compared bee abundance and diversity in the mowed plot to that in a contiguous, undisturbed control site. Bee abundance was significantly lower in the mowed site. Community composition also differed: in disturbed sites, there were more ground-nesting bees, while in the control site there were more twig-nesting bees.

Overwintering biology of the brown marmorated stink bug, *Halyomorpha halys.*

Ciancio, J.J.*, B.J. Sinclair, and T.D. Gariepy.
**jciancio@uwo.ca*

In temperate North America, insects risk exposure to several environmental stressors – including low temperatures, desiccation, and energy consumption – while overwintering. The brown marmorated stink bug (*Halyomorpha halys*) is an invasive crop pest which poses a significant threat to the Canadian agricultural landscape. Here, we investigate the tolerance of *H. halys* to low temperatures, desiccation, and energy consumption on a seasonal basis, in addition to investigating the role of diapause in enhancing stress tolerance. Moreover, we report the physiological responses seen in field-collected *H. halys* populations when exposed to environmental stress and describe potential pest management strategies based on our findings.

Evaluating the suitability of *Diadromus collaris* as a biological control agent for Diamondback moth in Canada.

Cock, C.*, P. Mason, and N. Cappuccino.
**christinecock@gmail.com*

Diadromus collaris, a solitary pupal endoparasitoid, has been proposed as a biological control agent for the suppression of Diamondback moth in Canada. The introduction of any new bio-control agent must be undertaken with caution; it is important to evaluate potential unintended impacts on non-target species. To determine whether any non-target lepidoptera are suitable hosts for *D. collaris* and/or whether *D. collaris* affects non-target mortality, female *D. collaris* were exposed to non-target pupae from eight lepidopteran species. The results of these host range tests will help to determine whether *D. collaris*

should be considered for introduction in Canada.

Lepidoptera diversity of the Trent University nature areas.
Conlin, B.
**basilconlin@trentu.ca*

Trent University is unique in Ontario because its campus mostly consists of natural areas. For the last eight years I have been surveying lepidoptera on the Trent campus and have compiled a list of over 800 species. This is significant because many provincially and globally uncommon and rare species were found to occur here.

Genomic tools for tracking invasive Africanized honey bees.
Dogantzis, K.A.*, and A. Zayed.
**kdogantzis@gmail.com*

Africanized honey bees (AHB) are a hybrid population considered undesirable for beekeeping due to their aggressive behaviour. Given the large-scale trade and movement of honey bees, there is concern that AHBs will spread from South America and the United States. Developing an accurate and cost effective assay to detect AHB is an important step towards restricting the accidental importation of AHB. Here, we used an extensive population genomic dataset to assess the genomic composition of native and commercial populations of *Apis mellifera*. This data was used to develop single-nucleotide polymorphism (SNP) genotyping assays that show high accuracy in differentiating bees as African or non-African.

Staphylinid diversity and community structure across a neotropical elevation gradient.
Dolson, S.J.*, E. Loewen, W. Hallwachs, D.H. Janzen, and M.A. Smith.
**dolsons@uoguelph.ca*

Environmental stress can act as an environmental filter on the individuals present in a given habitat. This can reduce a community's diversity and make its composition more phylogenetically clustered. We tested this prediction using Staphylinidae (Coleoptera) collected across an elevation gradient in northwestern Costa Rica. Using DNA barcodes and phylogenetic estimates of community structure, we found high species turnover across elevation and that diversity increased linearly with elevation. This diversity was negatively related to surface area and temperature and positively with precipitation. We suggest that historical biogeography, rather than contemporary environmental stress alone, has produced these diversity patterns.

Energetic benefits of small size among flying insects.
Duell, M.E.* and J.F. Harrison.
**duellmeghane@gmail.com*

Allometric scaling of flight metabolic rate (FMR) in insects is nearly always hypometric. However, few small flyers have been included in these trends. We find that FMR scales

hypermetrically among 13 stingless bee species ranging in body size from 1-115mg in body mass. Energy savings in smaller species are partially explained by differences in head and wing morphology that alter flight biomechanics and tradeoffs in physical forces at small size (friction vs. inertia). When compared to all flying insects, a breakpoint in FMR exists at 53mg body mass, below which flight costs are cheaper than expected.

Watersheds as the main factor in Carabidae distribution in Ontario's far north.
Fleming, K.J.*, J.A. Schaefer, and D.V. Beresford.
**kaitlynflemin@trentu.ca*

Large-scale geographic distributions of carabids are governed by macro-scale climatic factors. We tested five hypotheses of temperature, continentality, precipitation, elevation, and watershed to determine what factors play a role in carabid distributions across Ontario's Far North. We found that species diversity was not affected by any abiotic factor examined. However, species composition differed primarily by watershed. Our results suggest a mechanism operating at the watershed level, the downstream movement of flotsam, enhances the dispersal of carabids. This research is the first to examine how multiple abiotic factors affect present-day carabid biogeography in Ontario's Far North.

Negative selection in social insects.
Imrit, M.A.*, K. Dogantzis, and A. Zayed.
*imarshad@my.yorku.ca

Eusociality, characterized in part by cooperative brood care and reproductive division of labor, evolved independently several times in insects. The evolution of eusociality has been hypothesized to lead to differences in the extent of both positive and negative selection. My research will estimate the extent of negative selection in honey bees, bumble bees, and wasps through analysis of published population genomic datasets. My study will compare the relationship between the strength of negative selection and caste-specific patterns of gene expression, and examine if the strength of negative selection correlates with the level of social complexity in this species triad.

How does the lightness of a species assemblage change across elevation? Testing the thermal melanism hypothesis with two abundant and diverse insect families.
Janke, L.*, S.J. Dolson, D.H. Janzen, W. Hallwachs, and M.A. Smith.
**jankel@uoguelph.ca*

According to the thermal melanism hypothesis, ectotherms ought to be darker in colder environments to obtain more heat and lighter in warmer environments to avoid overheating. We predicted that insect assemblages in the cloud forest at the top of a neotropical mountain would be darker than those at the bottom. To test this hypothesis, we used insects from two families (Formicidae and Staphylinidae) from a decade of collections across a 1500m elevation gradient in northwestern Costa Rica (all imaged, tissue sampled, and DNA barcoded). We found that these two insect assemblages followed a trend that supported the thermal melanism hypothesis.

Comparing apples and oranges: fruit type affects *Drosophila suzukii* development time and cold tolerance.

Jiménez Padilla, Y*, L. Ferguson, and B.J. Sinclair.
**yjimenez@uwo.ca*

Drosophila suzukii, commonly known as spotted wing Drosophila, is a pest of soft-skin fruits such as cherries, grapes, and various berries. Females lay their eggs in healthy fruits, and larval feeding causes the fruit to spoil leading to low yields and economic losses. Since both larvae and adults of *D. suzukii* are chill-susceptible (killed by low temperatures before their body fluids freeze), post-harvest cold exposure can be used as a method of controlling this pest. However, the fruits the flies feed upon affect their physiology and the efficacy of the cold treatments. Therefore, to develop an effective cold exposure control it is important to take into consideration the crop we are trying to protect.

Changes in the known Canadian Auchenorrhyncha fauna, 1979-2018.

Kits, J.H.
joel.kits@agr.gc.ca

The known Canadian fauna of Auchenorrhyncha was about 1060 species in 1979, and has since increased more than 40% to 1491 species as of 2018. I will discuss some of the causes of these increases, including improving taxonomic knowledge and newly introduced species. Gaps in our existing knowledge and potential for further discoveries will also be discussed.

Modelling the complex population dynamics of an invasive midge (*Contarinia nasturtii* Kieffer).

Liu, J.*, B.A. Mori, R. Weiss, O. Olfert, J.A. Newman, and R.H. Hallett.
**jliu31@uoguelph.ca*

The presence of swede midge (SM) (*Contarinia nasturtii* Kieffer), an invasive insect from Eurasia, has caused a decline of over 60% of Ontario's canola acreage since 2011. Ontario-specific SM development information was used to build a population dynamics model for reliable emergence forecasting. Iterative changes were made to model parameters in accordance with a partial set of robust pheromone trap data from Elora, Ontario. Finally, the model was validated against the remaining trap data. The model accurately predicts economically-damaging peaks of SM throughout the growing season. This information may help mitigate future economic damage caused by this invasive insect.

A multi-gene hypothesis of Eristalinae relationships (Diptera: Syrphidae).

Moran, K.*, J.H. Skevington, X. Mengual, G. Ståhls, S. Kelso, A.D. Young, K. Jordaens, M. Reemer, S. Bot, J. van Steenis, A. Ssymank, M. van Zuijen, M. Hauser, G. Miranda, W. van Steenis, V. Mutin, M. De Meyer, M. de Groot, M.M. Locke, and C. Palmer.
**syrphidae@kevinmoran.com*

Multiple analyses have recovered the subfamilies Microdontinae, Syrphinae and Pipizinae

as monophyletic; however, Eristalinae is repeatedly recovered as paraphyletic. Twenty scientists from 13 countries have joined to assemble a phylogeny of Eristalinae. Nine genes form the backbone: COI, 28S D2–3, CAD1, AATS, Period along with three new loci (for a total of ~ 8kB of data). Utilizing the other three subfamilies as outgroups, taxa were chosen across Eristalinae with an effort made to include a member of every tribe and subtribe. Phylogenetic results, including evidence supporting the elevation of additional subfamilies, are presented and proposed next steps are discussed.

Revision of Middle East *Tomosvaryella* Aczél species (Diptera: Pipunculidae).

Motamedinia, B.* and J.H. Skevington.
**bmoetamedi@yahoo.com*

Pipunculidae are an inconspicuous family of brachycerous Diptera. Larvae are endoparasitoids of nymph and adult Auchenorrhyncha (leafhoppers, planthoppers and relatives), with the exception of *Nephrocerus* Zetterstedt. The latter parasitize adult Tipulidae (crane flies). To date, 1479 species of Pipunculidae are recognized. *Tomosvaryella* is a large and cosmopolitan genus of the tribe *Tomosvaryellini* currently including 283 valid species. From the Middle East, 31 species of *Tomosvaryella* are known. In this study we revise the *Tomosvaryella* of the Middle East. Species concepts will be based on morphological and molecular characters. We will present an overview of progress on the revision to date.

Integrating lab and field data in the establishment of a pheromone-based action threshold for swede midge (*Contarinia nasturtii*) in canola (*Brassica napus* L.).

Muzzatti, M. and R.H. Hallett.
**muzzattm@uoguelph.ca*

Current management recommendations for swede midge (*Contarinia nasturtii*) in canola (*Brassica napus* L.) may not be appropriate as they rely on action thresholds developed for cole crops (*B. oleracea* L.). In pursuit of the development of pheromone-based action thresholds for swede midge in canola, four different canola growth stages were exposed to various midge densities in laboratory cage experiments. Midge damage was rated, number of racemes and pods were counted, and seed weight was calculated. These results will be used in tandem with an analysis of a 4-year data set from threshold field-plot trials to determine threshold recommendations in canola.

The Frosted Elfin butterfly: a candidate for reintroduction to Canada.

Otis, G.W.* and A. Santos.
*gotis@uoguelph.ca

The Frosted Elfin (*Callophrys irus*), a specialist on wild lupine (*Lupinus perennis*), was last observed in Canada in 1988 in Norfolk County, ON. Habitat restoration undertaken by Nature Conservancy Canada and the St. Williams Conservation Reserve has created several geographically-linked lupine habitats that may be suitable for reintroduction of the

butterflies. This presentation will summarize the field work undertaken in 2018 that will provide background information in support of the recovery of the Frosted Elfin in Ontario.

Sociality of the Sweat bee *Lasioglossum zonulum* across Canada.

Proulx, A.N.M.* and M.H. Richards.
*ap17rz@brocku.ca

Sweat bees (Halictidae) exhibit substantial diversity in social behaviour, making them prime candidates for research on social evolution. The halictid *Lasioglossum zonulum* exhibits solitary behaviour in Europe; however, pan trap collections in the Niagara region demonstrate a flight phenology consistent with eusocial species. I plan to determine the social behavior of *L. zonulum* in Niagara and across Canada. Preliminary data from dissections that score wear and ovarian development show that *L. zonulum* is either eusocial or solitary with two broods. If it is shown to be the latter, *L. zonulum* could be an evolutionary stepping stone between solitary and eusocial behavior.

Sunny bees live faster.

Richards, M.
mrichards@brocku.ca

Small carpenter bees (*Ceratina calcarata*) raised in sun-exposed nests with very high daytime temperatures develop more slowly in the lab than do those from shaded nests with lower temperatures. Since developmental and metabolic rates are normally correlated, this suggests countergradient variation and thermal compensation. We set up a field experiment in which carpenter bees were raised in full sun, full shade, or semi-shade, then moved to the lab for respirometry. Contrary to prediction, bees raised in full sun had higher metabolic rates than those from shady nests, but only at high temperatures (40°C). This suggests the uncoupling of metabolic and developmental rates and thermal compensation by bees in hot nests.

Preference and performance of *Hypena opulenta* on *Vincetoxicum rossicum* foliage from sun versus shade habitats.

Rochette, A.* and N. Cappuccino.
*aliciarochette@me.com

Physical properties of individual plants within the same species can differ between habitats. Foliage characteristics such as leaf toughness and water content can be influenced by abiotic factors such as light intensity and temperature. These differences can also affect insect herbivores that feed on them. Here, we examine physical characteristics of *Vincetoxicum rossicum* between full-sun and shaded habitats. In addition, we determine larval performance of the biological control agent, *Hypena opulenta*, on full-sun and shaded foliage. Preliminary results suggest that *H. opulenta* preferentially feed on shaded foliage. Overall, this study will provide insight for optimal release sites for *H. opulenta*.

Utilizing citizen science for conservation: The success of bumble bee watch in Ontario.

Rowe. G.* and S.A. Johnson.
*g.rowe@wildlifepreservation.ca

Up to 30% of bumble bee (*Bombus*) species may be at risk of extinction. Bumble bees can often be identified to species from photographs making them an ideal group for engaging citizen scientists in population monitoring. In 2014, Bumble Bee Watch (BBW) was launched and has become a valuable tool used in Wildlife Preservation Canada's (WPC) citizen science programs. Records on BBW continue to help guide search locations for at-risk species, and an ever-expanding community of volunteers using BBW has vastly increased survey coverage across the province. BBW is an invaluable support to *Bombus* conservation across North America.

A sticky path to freedom: an assessment of pepper weevil escapes from sticky traps.

Russell, C.* and R. Hallett.
*rcassie@uoguelph.ca

The pepper weevil (*Anthonomus eugenii* Cano) has become a significant pest of field and greenhouse peppers in southwestern Ontario. The efficacy of the current commercially available pepper weevil monitoring trap is under scrutiny and a more effective trap design and lure are required. As part of a larger improved monitoring and management study, five brands of sticky cards and/or adhesives were assessed for the ability of weevils to move and escape from the traps. Factors such as temperature, sex, age, and position placed on trap were analyzed. Results will be used to provide recommendations for a more effective monitoring trap.

Canada's iconic Bogbean Buckmoth: resolving the problematic taxonomy of an endangered species.

Schmidt, C.
neoarctia@gmail.com

The bogbean buckmoth is a charismatic saturniid moth with a highly localized occurrence in fen habitats of the eastern Lake Ontario region, and is of conservation concern in Canada and the USA. Due to pronounced ecological specialization across North American buckmoth populations that are nevertheless morphologically homogeneous, the taxonomy of bogbean buckmoths has been in limbo, hampering conservation management and a better understanding of the group. Recent research applying molecular techniques shows some promising results in elucidating the taxonomy and biogeography of this iconic species.

Feed me Seymour: Using DNA to identify the arthropod prey items of carnivorous plants.

Smith, M.A.*, S. Adamowicz, E. Al-Harazi, L. Alleston, M. Anderson, S. Blanchett, A. Borrelli, K. Drotos, N. Duitschaever, B. Foy, A. Grant, S. Griffiths, A. Heuvelmans, N. Heyblom, J. Hoogenboom, V. Kaniewski, H. Lyttle, D. McIsaac, B. Moy, G. Schneider, A. Semenuk, S. Shrubsole, A. Varsano, E. Vellenga, A. Virostek, B. Wight, and H. Wynen.
**salex@uoguelph.ca*

Some plant species in nutrient-poor environments are carnivorous to augment nitrogen. However, knowing what arthropod species these plants prey upon is often not possible as the characteristics necessary for identification are absent from degraded field collections. As part of undergraduate field courses in Churchill, MB, and Algonquin Provincial Park, ON, we collected and DNA barcoded prey items from the common butterwort (*Pinguicula vulgaris*), sundew (*Drosera rotundifolia*), and pitcher plant (*Sarracenia purpurea*) to identify prey items to species. We will present preliminary findings about the species-level diversity and community overlap of the arthropod assemblages upon which each plant feeds.

Dissecting the genetic underpinnings of pathogen loads in the honey bee (*Apis mellifera*).

Tiwari, T.*, C. Kent, A. Dey, S. Rose, H. Patel, K. Dogantzis, and A. Zayed.
**tiwari.tanushree@gmail.com*

The honey bee *Apis mellifera* is a model organism for sociogenomics and is one of the most important managed pollinators. The recent threats to honey bee health are alarming. The honey bee lives in highly crowded nests providing favorable conditions for the spread of diseases. They have several social and individual mechanisms for protecting themselves against disease. The BeeOMICS consortium has sequenced the genomes of 1,000 colonies in Canada, evaluated for abundance of several pathogens within each colony. I will perform genome-wide association studies (GWAS) on colony pathogen loads to understand the genetics of immunity in them.

Does chilling elicit metabolomic changes in Asian Longhorned Beetle larvae?

Torson A.S.*, D. Doucet, A.D. Roe, and B.J. Sinclair.
**atorson@uwo.ca*

Overwintering capacity can mediate an insect's range expansion in temperate climates. The Asian longhorned beetle (ALB) is an invasive species native to China and Korea. Its native range spans a large latitudinal gradient, so native populations likely experience significant variation in winter conditions. However, little is known about ALB's overwintering strategy and whether it could survive Canadian winters. Here, we use an initial characterization of ALB's overwintering physiology to inform a metabolomic analysis throughout exposure to chilled temperatures. We observed significant separation of metabolomic profiles between chilled and non-chilled time points suggesting distinct physiological changes throughout chilling.

How does oxygen availability determine fumigation success?

Turnbull, K.F.*, J. Devitt, A. Najar-Rodriguez, and B.J. Sinclair.
**kturnbu9@uwo.ca*

Wood exports are frequently treated with fumigants within hypoxic (i.e. low oxygen) ship holds. However, the impact of modified atmospheres on fumigant efficacy against forest pests is unclear. Here, we use the golden-haired bark beetle, *Hylurgus ligniperda* (Coleoptera: Curculionidae) to test links between oxygen availability, metabolic rate, and fumigant efficacy. We found that metabolic rate varies between life stages and declines under hypoxia. We will determine how hypoxia impacts fumigation, testing if efficacy is a function of metabolic rate and oxygen availability. We discuss applications and limitations of our results to post-harvest fumigation under modified atmospheres.

Digging deeply into the morphology of minute flies: contrasting parallel taxonomic studies of *Pseudopomyza* (*Rhinopomyzella*) and *Bromeloecia.*

Yau, T.* and S.A. Marshall.
**tyau@alumni.uoguelph.ca*

Pseudopomyza (*Rhinopomyzella)* (Pseudopomyzidae) and *Bromeloecia* (Sphaeroceridae, Limosininae) are widely separated clades within the acalyptrates. These minute flies from the New World have strikingly different morphological qualities and expressions. *Pseudopomyza* (*Rhinopomyzella*) is a beautiful shiny subgenus, distinctively marked yellow and brown; however under its façade, it offers a limited and highly homoplastic character set. *Bromeloecia* alternatively is a dull-looking genus, yet species have character rich wings with striking wing interference patterns, and informatively elaborate genitalia. The comparison of these two contrasting groups suggest that the only thing they share is the remarkably high proportion of new species awaiting description and naming.

Genomics for bee health and conservation.

Zayed, A.
**zayed@yorku.ca*

Can we use genomics to help us assess and improve bee health? Wild and managed bees have experienced declines in health over the past several decades. I will discuss opportunities to apply emerging genomic tools in bee conservation and management, including the identification of loci underlying adaptive and economically desirable traits, as well as identifying environmental stressors that impact bee health in the field.

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